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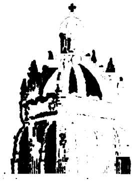
MODERN SCHOOL HYGIENE



First published in 1935. Made and printed in
Great Britain by The Aberdeen University Press
Reprinted . . . September, 1936
Revised and reprinted . . March, 1939
Revised and reprinted . November, 1940

MODERN SCHOOL HYGIENE

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JAMES NISBET & CO., LTD.
22 BERNERS STREET, LONDON, W.1

PREFACE

THE development of the Public Health Services during the present century has tended strongly to focus detailed attention on the welfare of the individual as contrasted with the general supervision of environmental conditions. As a result, the Child Welfare and School Medical Services have grown up, side by side, as important branches of the general Public Health Service.

School Hygiene is now one of the compulsory subjects of study for the examinations held by the various Training College Examinations Boards for those entering the teaching profession, and this book has been written primarily for students preparing for those and similar examinations. In order to keep the book within reasonable proportions, the physiology included is restricted to that necessary for a sound understanding of the subject of the book.

Attention devoted to apparently trifling ailments in young children not only often prevents serious ill-health in later life, but also enables the children to obtain the maximum of benefit from their education. In this connection teachers equipped with a sound knowledge of Hygiene can play a valuable part, and at the same time assist to raise the national standard of health and physical fitness.

The success of the School Medical Service in improving the health of the scholars and the Hygiene of the schools, is very closely correlated with the knowledge of Hygiene possessed by individual teachers and the practical application of such knowledge. In writing this book, therefore, an endeavour has been made so to present the modern views on School Hygiene as to make the book of practical value to Head Teachers and their staffs.

For the benefit of those to whom some of the technical terms used may not be familiar, a Glossary with indications of pronunciation has been inserted at the end of the book.

PREFACE

Though, as stated, the book has been primarily written for the teaching profession, it is hoped that it may also be found useful for those studying for the examinations held by the Royal Sanitary Institute for Health Visitors and by others studying or interested in School Hygiene.

My thanks are due to Dr. Ruby Bell for her assistance in the section on Infant Welfare; Dr. M. Barton Hall for her suggestions regarding Child Guidance Clinics; Dr. R. Jackson for information on the subject of Tuberculosis; Mr. T. H. Parsons for advice on the chapter on Dental Hygiene; Miss M. Lindsay for information concerning the education of children attending Special Schools; and Mr. A. Landstein for the plans to illustrate the chapter on School Premises.

In particular, I desire to express my indebtedness to Dr. Kingsford, for his invaluable advice and criticism, and also for his help in revising the whole of the text-matter.

R. GAMLIN.

In the Second edition a few minor alterations and additions were made throughout the book. In this Third edition the chapter dealing with School premises has been considerably revised, in consequence of the publication by the Board of Education of their new handbook dealing with the Planning of School Buildings.

During 1938 the Board also published a valuable Report dealing with Children with Defective Hearing, and reference is made to this Report at the end of Chapter XIV.

On the suggestion of certain Training College Lecturers some additional information on the subject of Infectious Diseases has been included.

Two further illustrations have been incorporated in Figs. 90 and 94.

R. G.

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CHAPTER I

HEREDITY

Theories of evolution. Structure of the cell and method of cell division. Mendelism. Examples of how present knowledge can be utilised.

PRIOR to Pasteur's discovery, about the year 1860, that living organisms were responsible for the process of decomposition, the theory of Spontaneous Generation was largely held, the great majority of people believing that it was not always necessary for all types of living things to have parents. It is now universally agreed that all living things have derived their existence from previous living things, and that a gradual process of evolution is always going on. From the pooling of evidence derived from different scientific sources, such as biology, embryology and geology, it seems fairly certain that all the complicated forms of present-day life have evolved from the simplest forms of protoplasmic life, which probably were in existence about a thousand million years ago. In the course of time many of the intermediate evolutionary forms have become extinct, but a number of the existing species represent links in the evolutionary chain.

Several theories have been advanced in explanation of the method by which evolution has come about. One of the earliest of these was that of LAMARCK, a French scientist, whose views on evolution were published in 1809. He considered that body changes brought about in the lifetime of an individual are transmitted to the offspring. His view was known as that of " The effects of use and disuse," because he thought that the more any particular organ is used the better developed it becomes in the individual and probably also in the offspring. Conversely, if an organ be not used it will gradually become functionless and may possibly disappear in later generations. Thus, according to his theory, animals living in dark caves would eventually lose all power of sight. The main tenets of this belief are held by some present-day workers, and the theory is now referred to as *The Inheritance of Acquired Characters.*

The next important theory to be mentioned is that known as *Natural Selection,* which, by a remarkable coincidence, was propounded about the same time by two friends, CHARLES DARWIN and ALFRED RUSSEL WALLACE. Their theory is more popularly referred to as that of *The Survival of the Fittest.*

The basis of the theory is that although the tendency of all living things is to increase in geometrical progression, the numbers of the different species remain approximately always the same, Nature's method being to arrange for an enormous over-production of individuals, of which only the fittest survive. For example, in many fishes, a single individual lays thousands of eggs, but owing to the high mortality among young fish only a few reach maturity.

Charles Darwin, in his book "Origin of Species," published in 1859, drew attention to the fact that all members of a species were not exactly the same, and that numerous slight differences or variations were appearing from time to time. He reasoned that if any of these variations gave the animals concerned an advantage over the other animals of the species, the better endowed would have a greater chance of surviving, and the advantageous variation would be handed on to the offspring.

The long neck of the giraffe, under the Lamarckian view, would be caused by deer-like animals constantly stretching their necks for countless generations to get at foliage on the high branches of trees, the physical effect of such stretching of the neck being transmitted to the offspring. Lamarck further believed that the conscious and unconscious desire of the deer to reach higher branches resulted in an actual and transmissible increase in the lengths of their necks.

The Darwinian explanation would be that in past generations the ancestors of the giraffe were faced from time to time with severe droughts, and only those animals survived which had necks sufficiently long to enable them to secure the last remaining foliage on the tops of the trees, whilst those with shorter necks had to starve and so died out, and that the longer necks were inherited characteristics.

Briefly then, Darwin's theory comprises over-production with variability, a struggle for existence, resulting in the elimination of the unfit and the survival of the fittest, and an inheritance of the features of survival-value; whilst Lamarck held that environmental circumstances produced slight modifications which were inherited.

When Lamarck and Darwin put forward their theories of the methods by which evolution was brought about, the sciences of embryology and biology were not sufficiently developed for these theories to be fully investigated on these lines, but their authors made no claims for infallibility in their views.

Towards the end of the nineteenth century a new view of heredity was propounded by Weismann. It was based on his observations of cells during their process of division and was in direct opposition to the theory of Lamarck. Weismann held that environmental circumstances, whilst they might produce a change in the individuals concerned, did not in the least affect the offspring.

A description of the structure of a cell and the method of cell reproduction will now be given, as knowledge of these matters is necessary for the proper understanding of Weismann's theory as well as the even more important theory of Mendel, which will be described later.

All living things both in the animal and vegetable kingdoms are made up of cells composed of a soft granular jelly-like substance called protoplasm. The simplest forms of life consist of a single cell, one well-known example being the amœba, which exists in pond waters. When examined under the microscope the amœba is seen to consist of an undifferentiated mass of granular protoplasm called cytoplasm without a definite cell-wall, but with a deeper central portion called the nucleus. It has the power of movement, can envelope and digest minute particles of food and get rid of the undigested parts. It also has the power of multiplying its species by the simple process of dividing into two, each half subsequently growing to the size of the parent.

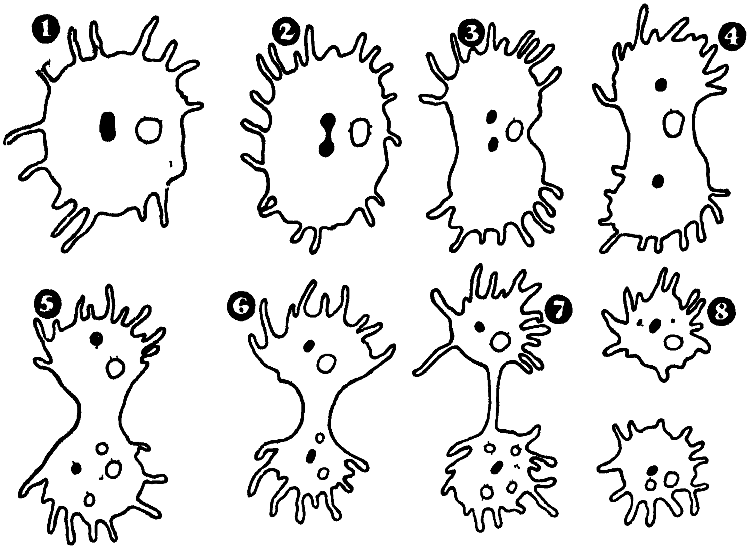


FIG. 1. *Division of Amœba* Eight stages in the division of an amœba into two independent amœbae 1 Amœba about to divide 2 Beginning of the division of its nucleus 3 Nuclear division complete 4-7 Advancing stages of division of the "body" of the amœba 8 Division complete

(*From "The Functions of the Body," by V H Mottram*)

The higher organisms, including man, are made up of many millions of cells, and just as in a civilized community it is necessary for all the different individuals to specialize in certain directions, such as food producers, makers of clothing, policemen, teachers, postmen, etc., so in the case of multi-cellular organisms certain of the cells take on specialized functions as blood cells, muscle fibres, bone cells, glandular cells, brain cells, reproductive cells etc.; and are modified accordingly.

The structure of a simple unspecialized type of cell is very like that of the amœba. The protoplasm which forms the body of the cell is called cytoplasm. This cytoplasm, which is mainly responsible for the general nutrition of the cell, is contained within a thin cell membrane. In the cytoplasm there are sometimes small spaces known as vacuoles and there are also some small bodies known as plastids. These cytoplasmic structures are probably not concerned in heredity and need not, therefore, be further discussed here. Near the centre of the cell, however, is a different kind of protoplasm, which is called the nucleus, and this is also surrounded by a thin membrane. In the nucleus itself are a number of granules to which the name chromatin is given, and also a number of delicate supporting thread-like substances which are termed the " linin " network. These latter, together with a star-like structure called the centrosome, are known as the achromatic figure. The nucleus plays an important part in the life of the cell, and is especially concerned in cell reproduction.

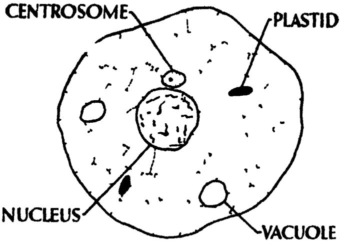


FIG. 2. *Diagram of a Cell.*

All cells have the power of propagating their kind by dividing into two, each half growing as large as the parent cell. When such a cell is about to divide, the centrosome first of all divides into two (Fig. 3*a*), the products of the division migrating to opposite ends of the cell, and the two are joined together by numerous fine threads of protoplasm called the spindle (*b*). Whilst this has been taking place the chromatin granules have run together into a thickened thread, which arranges itself in a zig-zag manner around the equator of the spindle, and then becomes broken up into V-shaped pieces called chromosomes (*c*) and (*d*). Each of these now splits along its length into two V-shaped chromosomes (*e*), the split halves then separating and being drawn away towards the two centrosomes, apparently by the contraction of the spindle fibres (*f*). Thus, at each pole of the cell appears the original number of chromosomes, but each is only half the original size.

A constriction then appears in the middle of the cytoplasm (*f*) and (*g*) and the parent cell splits into two, each with its own complement of chromosomes, after which the chromosomes disorganize into granules again, and fresh nuclei appear in each of the halves (*h*). Thus two new cells are produced, each of which possesses exactly one half of the original chromatin material present in the parent cell, but the same number of chromosomes. This process of cell division with accurate halving of the chromatin material occurs when any of the ordinary body cells divide, as, for instance, during the growth of the organism.

It has been observed that the number of chromosomes formed during the process of cell division is always constant for any one species, though the numbers formed in different species vary according to the species. In the great majority of organisms in which two sexes are differentiated, certain cells in each sex, known as germ cells or gametes, are specialized for reproduction purposes only. When this takes place it is necessary for the male gamete and the female gamete to come together and fuse completely into a single cell called a zygote, which is the earliest form of the future new individual. It is the zygote which forms the fertilized egg in animals and the seed in plants.

It might be thought that by the fusion of the male and female gametes double the normal number of chromosomes

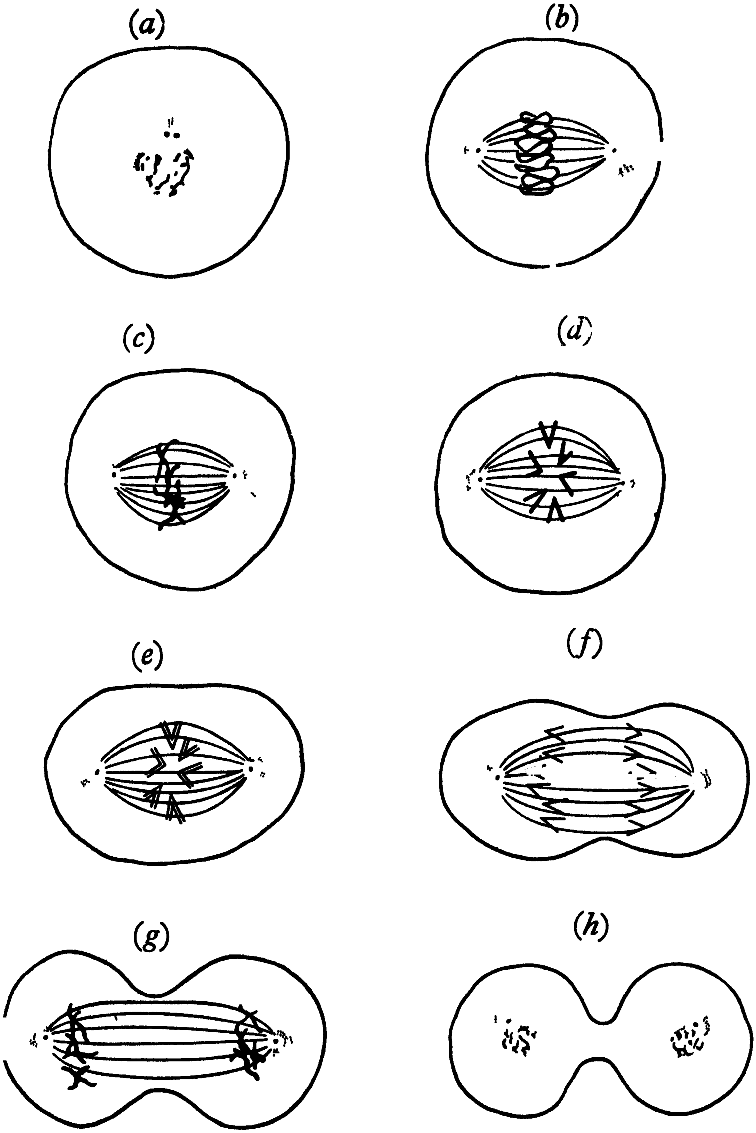


FIG 3. *Diagram of Cell Division.*

would appear in the zygote, but nature has evolved a method whereby both the male and female reproduction cells, before they become mature, shall have their chromosomes halved by a special reduction division so that after their fusion the zygote shall only have the correct number of chromosomes characteristic of the species, one half being derived from the male parent and the other half from the female.

To return now to Weismann's view of heredity, which may be expressed as the theory of the *Continuity of the germ plasm.* He held that hereditary characteristics were probably contained in the nuclei, and were transmitted from one generation to another. Although he had no exact knowledge of the intricate cell structure and nuclear-behaviour described above, Weismann did recognize the nucleus as a complicated substance, and he suggested that it might be divided up into regions which were the bearers of inherited characters. He reasoned that there was a fundamental difference between the germ cells and the rest of the body cells, and that the function of the latter was merely the nourishment and protection of the former, the body cells themselves being quite incapable of reproducing the species, which was the sole function of the germ cells. All the substance of the germ cells was not used up in the construction of the body of the offspring, a portion being reserved unchanged for the formation of the gametes of the next generation. He held also that the effect of environment on the body cells could in no way affect the offspring, and that the germ cells alone were responsible for the particular characteristics of the offspring. His theory was, therefore, directly opposed to that of Lamarck.

As it has been observed that in the process of ordinary cell division the chromosomes in the nucleus divide in a longitudinal manner, it is considered by modern workers that the various hereditary factors are arranged side by side in a longitudinal direction along them, somewhat like contiguous beads on the string of a necklace (see Fig. 6, page 16), and that when the chromosomes split into halves, the contained hereditary factors likewise became equally divided, so that each new cell has all the hereditary characteristics possessed by the parent cell. The modern biologist whose name is most closely associated with this theory is Charles Morgan, who has observed many interesting phenomena in the nucleus of the gametes of a small fruit fly.

In 1890 PROFESSOR DE VRIES of Amsterdam published some important observations concerning the origin of new species in the vegetable kingdom. He found that certain new species arose, not as Darwin thought as the result of slight continuous variations having an advantageous value, but in consequence of changes of considerable magnitude arising suddenly and spontaneously. These sudden, big changes when they breed true he called Mutations, and his theory is spoken of as *The Mutation Theory.*

The most important contribution of all to the theories of heredity has come from an unexpected quarter. Shortly after Charles Darwin and Wallace had published their views on heredity an Austrian monk, named GREGOR MENDEL, who was a keen gardener, read, in 1865, before the Natural History Society of Brünn, a paper on the "Laws of Heredity," based on the results of his experiments in the cultivation of garden peas. Very little notice was taken of this paper at the time, possibly because scientists were then occupied in attacking Darwin's "Origin of Species."

About the beginning of the present century attention was drawn to this forgotten paper by de Vries in Holland, and Bateson in this country, and some others who extended Mendel's experiments. The full significance of his discoveries is now appreciated, and they form the foundation of the modern views on heredity.

Mendel had long been puzzling over the great number of variations among his garden peas. Some of the seeds were yellow, some green; some of the seeds were wrinkled, others smooth ; the flowers varied also in colour, and some of the plants were tall and others short. To find whether there were any laws governing the inheritance of these variations he made many experiments, fixing his attention on one character at a time, in order to simplify the issue and thereby avoid possible complications. The facts upon which Mendel formulated his theory may best be explained by describing one of his experiments.

He crossed flowers of a tall form of pea plant with pollen from a dwarf form, both of which had previously bred true to type, *i.e.* had given rise respectively only to tall plants or short plants. It might naturally be expected that the hybrid, or cross bred, offspring of such parents would participate in the characters of both parents, but on raising the first generation of hybrid plants in this cross the somewhat remarkable discovery was made that all the plants were of the tall variety.

Mendel then allowed these tall hybrid plants to produce seed in the normal way, namely, by self-fertilization. The second generation, when thus raised, was found to consist of two classes—talls, which were of equal stature to their tall parents and to their tall grandparent, and dwarfs, which were just as short as the dwarf grandparent. There were no intermediate sizes. Moreover, the number of dwarfs of this generation bore a constant proportion to the whole, namely, 25 per cent. dwarfs, or one dwarf to every three tall, and these dwarfs, if allowed to self-fertilize themselves, always bred true, that is, produced only dwarf offspring. Thus he was faced with the puzzling inconsistency of a dwarf plant being produced by a hybrid tall parent, and the natural offspring of the dwarf being all, without exception, also dwarfs.

His next interesting observation was on the behaviour in breeding of the tall hybrid plants of the second generation. Among these, when self-fertilised, some produced only pure talls, whilst others also produced hybrid talls and pure dwarfs, and where the two varieties were produced it was again in the ratio of 3 tall to 1 short.

These experiments of Mendel may be represented diagramatically as follows—T representing a tall sweet pea and D representing a dwarf sweet pea, whilst T(D) represents a hybrid tall.

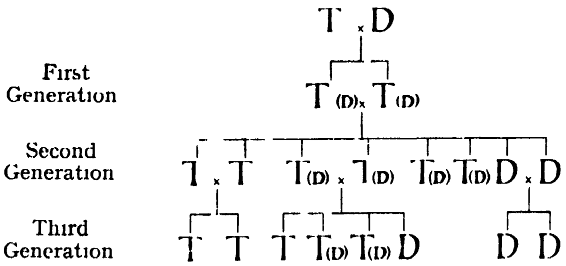


FIG. 4. *Diagrammatic representation of one of Mendel's Sweet Pea Experiments.*

There must, therefore, have been two kinds of tall plants in this second generation, some of which were pure-bred with regard to the factor for tallness, whilst the others were not. It was actually found in this generation descended from hybrid parents that 25 per cent. of the offspring were pure-bred as to one of the factors concerned, 25 per cent. were pure-bred as to the other factor concerned, whilst in 50 per cent. both of the factors were present.

In this experiment a number of striking phenomena were brought out. These include what are known as *Dominance* and *Recessiveness* and also *Segregation.* Dominance is the term used when there is a complete outward resemblance in the first hybrid generation to one of the parents, the characteristic of the other parent being temporarily suppressed or recessive. In this particular experiment the characteristic which masked the other was the factor for tallness, which he called the " dominant " factor, whilst the characteristic which was masked, in this case dwarfness, he called the " recessive " factor.

The second phenomenon, "segregation," is responsible for the separating out in the second generation, in definite mathematical proportions, of the two factors which were responsible for the different characteristics manifested by the original parents, and which were combined in the first hybrid generation.

In explanation of the facts described above, Mendel put forward two suggestions, which are generally known respectively as Mendel's first and second laws.

The first of these laws is known as that of the *Purity of the Gametes.* It states that when the gametes, or germ-cells, are formed. each may contain one of a pair of contrasting characters, but cannot contain both. For example, in the above experiment of Mendel, each individual gamete may contain either the character for tallness or dwarfness but never both. This law has been proved by innumerable subsequent experiments to hold good for all plants and animals.

The second law of Mendel is that of the *Free Segregation of the Gametes.* According to this law, it is purely a matter of chance which factor of a pair of contrasting characters any particular gamete receives, since there is a free separation or segregation of gametes at reduction division. The two kinds of gametes are therefore produced roughly in equal numbers.

In Fig. 4, in the line showing the second generation, there appears one lot of plants, "T," possessing only the factor for tallness, a similar number of plants, "D," possessing only the factor for dwarfness, and twice as many plants T(D) which, though tall, possess factors both for tallness and dwarfness. But, in the case of any particular plant in this generation, it is just a matter of chance whether it has received the factor for tallness only, or for dwarfness only, or both of these factors.

In hybrids resulting from the crossing of an organism possessing a dominant factor only with one possessing the

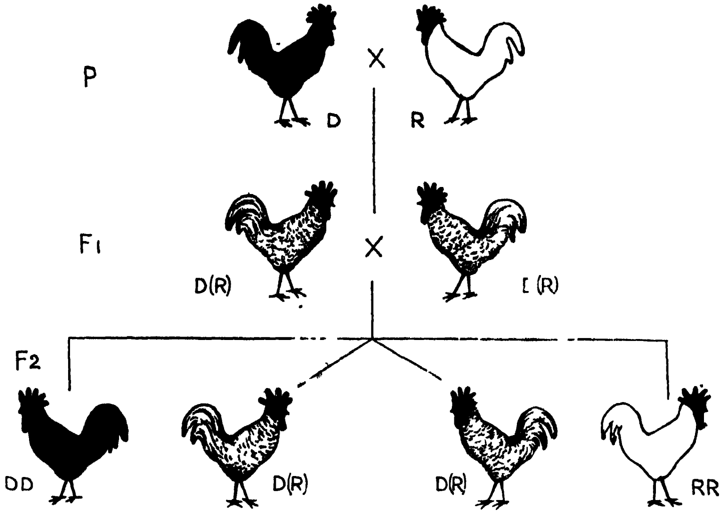


FIG. 5. *Mendelian Inheritance in Andalusian Fowls.* P = parents. F_1 and F_2 the first and second generations. D = dominant. R = recessive. D(R) = hybrid.

(From "The Outline of Science," by permission of Messrs. George Newnes, Ltd.)

corresponding recessive factor only, the dominance is not always complete. The following example of incomplete dominance will help to make more clear the Mendelian law with regard to the inheritance of dominant and recessive factors. If a pure bred black Andalusian fowl be crossed with a pure bred white Andalusian fowl, since the factor or gene, as it is now sometimes called, for blackness is only partially dominant to that for whiteness, the hybrid offspring appear as a kind of speckled black, the so-called " blue " Andalusians.

The offspring from two " blue " Andalusians are in the ratio of 1 black, 2 blue, and 1 white, as shown in the accompanying diagram.

The only possible explanation of these heredity phenomena is that the factors causing such characters as height, colour, etc., are definite units, existing in pairs in every individual immature germ cell, which become separated on the maturing of the germ cell, with the result that only one member of any pair is present in the mature germ cell. This, of course, is Mendel's first law of the purity of the gametes. If B represents a reproductive cell containing the factor for blackness, and W represents one containing the one for whiteness, then a hybrid male produces B and W gametes in equal numbers, and similarly in the case of a hybrid female, but neither produces a gamete containing both B and W.

To explain the ratio which occurs as the result of a cross of two hybrids, the B gametes and W gametes of both male and female blue Andalusian fowls may be likened to a mixture of black and white marbles in equal numbers in two separate bags. If individual marbles be picked at random out of each bag and placed in pairs as picked, it will be found that when a hundred pairs have been picked out, about 25 pairs will be both black, 25 pairs both white, and 50 pairs a black and a white, that is, in the proportion of one black pair and one white pair to every two pairs of black and white, which is precisely the same proportion found on crossing two blue Andalusian fowls, as shown in Fig. 5. As is well known, according to the laws of chance, the proportion becomes more exact the larger the numbers used. In many breeding experiments when two hybrids are crossed it is found that the offspring produced are in the same mathematical proportions, and this is spoken of as the *Mendelian ratio.*

It will be remembered that it was stated that in sexual reproduction the male and female germ cells before fusion halve their numbers of chromosomes, so that on fusion the correct number of chromosomes characteristic of the species are again produced. Since Mendel's time it has been proved beyond doubt that the various hereditary factors are carried in these chromosomes. Now when the male chromosomes meet the female chromosomes and fuse, the resultant combination of factors follow the laws of chance above described, and the Mendelian ratio is thus produced.

The demonstration that the chromosomes were the bearers of the hereditary factors was first established experimentally by Morgan in New York, and it was he who first adopted the word gene, now accepted by many biologists. A *gene* is an element in the germinal material (chromosome) more tangible than anything expressed by the word factor. He had been examining the chromosomes of certain flies, and found that some of the various male and female flies had not identical chromosome groups, one sex either having one more chromosome than the other, or one of a different size from the rest. These unlike chromosomes determined the sex of the animal, a fact that has been found to be true for most animals.

For example, in the case of round worms, the male has two kinds of germ cells, one of which contains six chromosomes, whilst the other contains only five chromosomes, whilst the female germ cells always have six chromosomes. If a male germ cell containing six chromosomes fertilises a female germ cell, the offspring is female; but if the male germ cell contains only five chromosomes, the offspring is of the male sex. In the case of the horse, sheep, cow, pig, and rabbit, and also man, the male germ cells contain one large chromosome, X, and a smaller one called the Y chromosome, while the female has two large X chromosomes and no Y. If a male germ cell containing an X chromosome fertilises the female the offspring is female, but if the male germ cell is of the Y variety the offspring is male.

This differentiation of such special sex chromosomes has thrown light on many previous difficulties. Thus, colour blindness, which is commonest in males, is always inherited through the female, and if, as is likely, the gene responsible for this defect is located in the sex chromosome, the explanation becomes quite clear. Hæmophilia, an affection from which the last Tsarevitch suffered, is a disease of the male sex, in which the sufferer is liable to severe hæmorrhage after trivial injuries, such as a slight cut or tooth extraction, and is transmitted through the unaffected female, this form of heredity being spoken of as Sex-linked.

Morgan has conducted much brilliant research, and has actually been able to map out the exact position of some of the genes in the chromosomes. He has also shown how, by accident, some of the genes in contiguous chromosomes may be transposed from one chromosome to the opposite one at reduction division, and has also demonstrated that the genes themselves are subject to sudden mutations, thus confirming de Vries's theory.

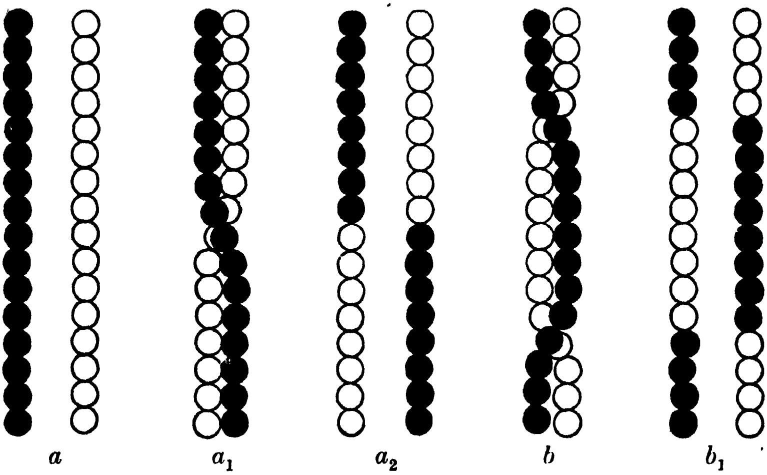


FIG. 6. *Diagrammatic representation showing how the Genes in Chromosomes may become crossed.*

(From "The Mechanism of Creative Evolution," by permission of G. G. Hurst and the Cambridge University Press.)

Muller has also shown that by the action of outside agencies, such as X-rays, changes could be brought about in the genes of the chromosomes, and mutations of the species created.

Further experiments have shown that not one gene but several may be responsible for determining certain characteristics, *e.g.* colour. In such cases the explanation, on Mendelian lines, of the interaction of the genes becomes highly complicated, and is only suitable for discussion in an advanced text book on heredity. It may be mentioned.

however, that musical ability is attributable to such an interaction of several genes, and pedigrees of musical families have been worked out which closely follow Mendelian expectations.

In 1932 Hurst published a most valuable contribution, in which he showed that the degree of intelligence in man is determined by the particular combinations formed by a variety of genes. He stated that there is one major gene which he calls N, which if present, determines that the intelligence will always be normal. There are, however, other genes also, A, B, C, D, E, and a, b, c, d, e, all of the former, having the power *in the absence of the gene N*, of increasing the amount of intelligence, whilst in similar circumstances, the latter decrease it.

According to the particular combination of genes in the absence of gene N the individual will be one of the following 10 grades, Illustrious, Eminent, Brilliant, Talented, Able, Mediocre, Dull, Subnormal, Feeble-minded, Imbecile.

The following are a few examples of characters which have been shown to be inherited on simple Mendelian lines:—colour in mice, rabbits, fowls, pigeons, and flowers, length of hair in certain animals, the Manx cat's tail, the presence or absence of horns in cattle.

Practical advantage has already been taken of the knowledge of these laws, and they have been applied to the production of desirable characteristics required for special purposes, *e.g.* breeding has been carried out on Mendelian lines to secure immunity from disease, and to increase egg production in fowls.

At the School of Agriculture in Cambridge, Sir Rowland Biffen, by breeding experiments on Mendelian lines, has succeeded in blending into one variety of wheat the desirable qualities obtained from several varieties, such as freedom from disease, richness in gluten, and strength of stem to resist damage from storm.

Professor Crew of Edinburgh has made a study of the

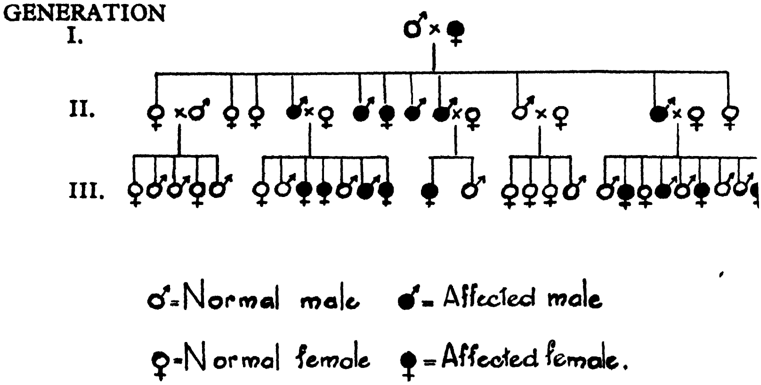


FIG. 7. *Pedigree of an Eye Disease, transmitted as a Mendelian Dominant Character.*

pedigrees of thousands of cows with records of high milk production, and has shown that this desirable quality is transmitted as a sex-linked factor.

The study of hereditary characteristics in man is much more difficult, because there are probably altogether many thousands of genes which interact in highly complex ways and not in the simple manners shown in the examples given of dominant, recessive, and sex-linked types.

This difficulty is increased by the fact that the study of the transmission of human hereditary characteristics cannot be carried out experimentally, and a further difficulty is that intermarriage of very close blood relations is not permitted. Further, there is the long interval of time which elapses between succeeding generations, and the fact that the average number of children to each family is comparatively small.

Despite these difficulties, there have already been discovered certain important defects which are transmitted in a simple straightforward manner, and a knowledge of these defects and the method of their transmission ought to be more generally known by the public.

Sometimes when a certain defect is known to occur in a

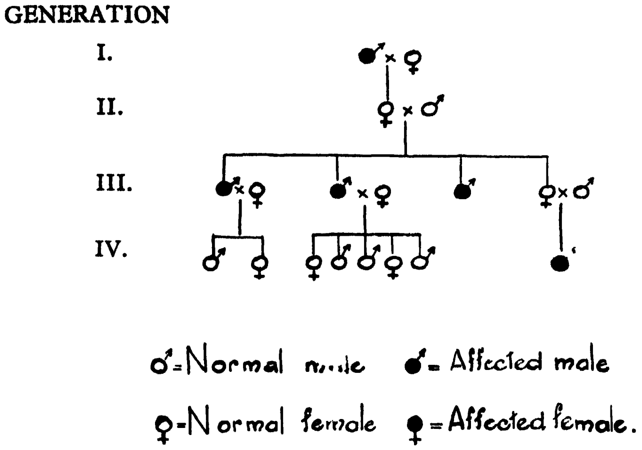


FIG. 8. *Pedigree of an Eye Disease, transmitted as a Sex-Linked Character.*

family, some members of it may be anxious to know whether they ought to marry, or if they do marry, what is the likelihood of their children being affected. In such cases a knowledge of the family pedigree may throw considerable light on the subject. Thus, if it is found that the defect is transmitted as a dominant characteristic, it is quite certain that the defect will not be transmitted by any member of the family who does not manifest it. On the other hand, in the case of any person manifesting such dominant defect, it may quite safely be predicted that on marriage with a normal mate, approximately one half of the children of such a union would be affected. (Fig. 7.)

If the defect only very rarely occurs in a pedigree it is probably a recessive, and there is little risk in marriage, since the characteristic will only appear when both parents are carriers of this recessive characteristic, a most unlikely circumstance, though it would be a wise precaution to examine also the pedigree of the other prospective party to the marriage, to eliminate the possibility of both members carrying the recessive characteristic. If the defect is always confined to the same sex, it is probably sex-linked, and is likely to be transmitted by those members not manifesting the defect. (Fig. 8.)

The present knowledge regarding the various principles involved in heredity may be epitomised as follows :—

(1) All the members of the vegetable and animal kingdoms, including man, may be regarded as communities of specialized cells, which have originated from a single individual cell, the zygote, which was formed by the union of two parent cells, known as gametes.

(2) The nucleus of the zygote contains chromosomes, half of these being derived from the chromosomes of each parent cell.

(3) The chromosomes contain substances called genes, which control the occurrence of certain characteristics in the offspring.

(4) There are special chromosomes which have the property of determining the sex of the offspring, and these chromosomes sometimes contain genes responsible for hereditary diseases, the transmission of which is therefore sex-linked.

(5) More than one gene may be concerned in determining certain characteristics in the offspring.

(6) The genes are transmitted according to certain principles, discovered by Mendel, who demonstrated that some genes could dominate others, and that when dominant and recessive characteristics are present in both hybrid parents, these characteristics become segregated out in the offspring, in definite mathematical proportions according to the laws of chance.

(7) All the germ plasm of the zygote is not used up in the formation of the body of the offspring, a portion remaining unchanged to form gametes for the next generation.

(8) Nature is continually experimenting with the genes, and bringing about slight variations and also big variations, known as mutations. All profitable variations enhance the chances of the survival of the species, whilst unprofitable variations diminish the chances (Natural Selection).

(9) It has been shown experimentally, that environmental conditions, such as exposure to X-rays, can bring about changes in the genes and consequently mutations.

(10) Acquired characteristics, in all probability, do not affect the germ plasm.

CHAPTER 2

DUCTLESS GLANDS

The Thyroid Gland. Cretinism and Myxœdema. The Thymus Gland. The Pituitary Gland. The Suprarenal Glands. The Pancreas. The Pineal Gland.

THE term " ductless glands " is applied to certain glands of the body which secrete special chemical substances which are passed into the blood or lymph stream to be carried to other glands or tissues the actions of which are thereby influenced. These glands are called ductless because, unlike such glands as the salivary and sweat glands, the secretions of which are taken from the glands by means of ducts or tubes, the ductless glands have no such ducts. These glands are also referred to as Endocrine glands and their chemical secretions are known as *hormones* or *endocrines.*

It is probable that in normal individuals there is always a supply of the different hormones circulating in the blood, but the amount of any one of these can be modified according to the body's requirements. A peculiarity of these hormones is, that though they are free in the general circulation, they have a definite selective action only on particular organs or tissues.

Some of the hormones work in close association with the sympathetic nervous system, and it has been suggested that this system of chemical messengers is an ancestral relic of the times before man's highly complex central nervous system was evolved, when, in the absence of the more speedy nerve tracks, messages had to be sent via the blood stream.

Evidence supporting this view lies in the fact that some of the endocrine glands act in close association with the sympathetic nervous system.

The sympathetic nervous system consists of two chains of nerve fibres running along the front of the vertebral column, each of these chains having on their course swellings called ganglia, which consist of massed collections of nerve cells and control the blood supply and the actions of the various internal organs of the thorax and abdomen.

One of the first hormones to be discovered was that known as *secretin*, which is manufactured by certain of the epithelial cells of the DUODENUM, as the result of the stimulus received when food is passed from the stomach into the duodenum. The secretion enters the general blood stream, and in the course of its circulation passes through the pancreas, and causes this gland to secrete the pancreatic juice which is necessary for the continuation of the digestion of the food in the small intestine.

The THYROID GLAND is a highly vascular organ consisting of two lobes, lying one on each side of the trachea, these lobes being united by a central lobe in front of the trachea. Normally the gland is not large enough to be noticeable externally, but if slightly enlarged it causes a fullness of the neck, which in women is regarded as a point of beauty. The paintings of beautiful women by artists are sometimes characterized by a fullness of the neck, suggestive of slight thyroid enlargement.

The hormone secreted by this gland, known as *thyroxin*, contains iodine, which exerts a marked influence upon the nutrition of the body and the metabolism of the tissues. For reasons not yet understood this gland may fail to secrete the hormone in sufficient amount, the effect upon the body being spoken of as hypo-thyroidism, whilst, on the other hand, the gland may secrete an excessive amount of thyroxin, resulting in the condition spoken of as hyper-thyroidism.

When hypo-thyroidism is marked in extent it results in well-marked disease. If it occurs at birth it produces the condition known as Cretinism, when it occurs at a later age the condition is known as Myxœdema.

CRETINISM develops among children in certain localities, particularly in Switzerland, Northern Italy, and certain parts of India and America. In this country cases are more prevalent in Derbyshire, the West Riding of Yorkshire, and Somersetshire than elsewhere.

Though very little is known of its cause, it is supposed to be due to a deficiency of iodine in the water supply, but it has also been suggested that it is due to some infective organism in the water supply. There appears to be some indication of a hereditary predisposition.

In cases of cretinism it is of the utmost importance that treatment should be commenced as early as possible and be regularly continued, the usual method adopted being the administration of tablets made from dried animal thyroids. The dose requires to be carefully regulated and the patient should be under constant medical supervision.

Since the early recognition of the condition is of such importance the early symptoms should be known. Generally speaking the child's growth and progress is retarded, he is apathetic and slow in all movements, the tongue may appear to be too large for the mouth, the skin is dry, rough, loose and wrinkled, and the hair on the scalp and eyebrows scanty. The child is decidedly late in walking and talking.

In untreated cases, as the child grows older there is considerable dwarfing, the legs appear too short and are often bowed, the hands and feet are broad and stumpy and the head large. The facial appearance is typical, the eyes are set widely apart, the bridge of the nose is poorly developed, giving a broad, flattened pug-nosed appearance, the lips are thickened and the tongue is coarse and often protruded. The skin feels dry and rough and appears redundant, whilst the hair is rough and scanty. The neck is short and thick, and there are often fatty swellings above the clavicles.

The abdomen is prominent, and the external genitals remain infantile in appearance. Mentally there is a general retardation or impairment of intelligence, and the majority of these cases are imbeciles or even idiots.

Sometimes for some unknown cause the thyroid gland, which previously has been normal, atrophies, causing the condition which is known as MYXŒDEMA. Though occasionally developing during school life, its commencement is usually about middle life, and it is much more common amongst females than males. Persons suffering from this disease manifest a characteristic appearance. The eyelids, nose, lips, and tongue are thickened, the expression is dull and apathetic, the skin is dry, thickened, and yellowish, whilst the cheeks over the malar bones show a bright flush. The hair often falls out, even that of the eyebrows and eyelashes. The hands are broadened and spade-like in shape. The general metabolism is slowed down, with the result that both mental and physical activities are considerably retarded. The condition can be materially improved by treating the patients with preparations made from sheep's thyroids.

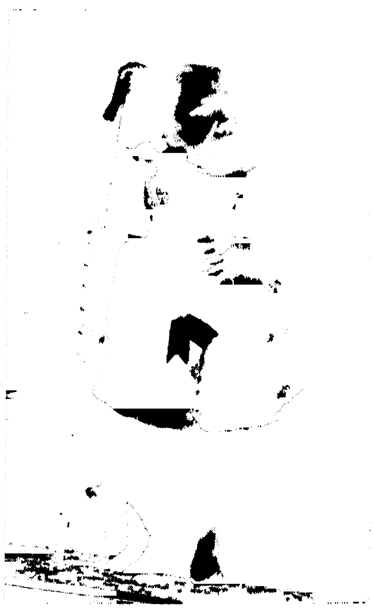


FIG. 9. *Adult Cretin, aged twenty-two years.*
(Photo kindly supplied by Dr Herd.)

When hyper-thyroidism is present it is characterized by a speeding up of the body metabolism, and the disease known as EXOPHTHALMIC GOITRE shows the effect of this condition. In this disease there is usually a noticeable enlargement of the thyroid gland, associated with a marked prominence of the eyeballs, which results in an unusual amount of the whites of the eyes being shown, thus producing a startled expression. The speeding up of the nervous system is shown by increased rapidity of the heart's action, muscular tremors, irritability, sleeplessness and excitability.

Apart from the diseases of the thyroid above mentioned, the gland sometimes enlarges without producing any noticeable symptoms, this condition being spoken of as Goitre. Goitres are common in those districts in which Cretinism occurs.

Situated at the side of and behind the thyroid gland on each side of the neck are very small glands, two on each side, known as the PARATHYROIDS, which secrete a hormone, known as *parathormone*, which seems to have an important function in regulating the calcium and phosphorus metabolism of the body. In operations upon the thyroid, great care has to be taken not to remove these glands, otherwise serious nervous manifestations result, muscular actions become irregular, and the blood loses its clotting power.

The THYMUS GLAND is a ductless gland situated in the thorax behind the upper part of the breast bone, and its internal secretion appears to have the function of delaying the premature onset of puberty. This gland usually diminishes in size during the years of childhood, finally disappearing almost entirely at the age of fifteen. In cases of unexplained sudden deaths in children it is often found that this gland is unusually enlarged, together with other glands of the body, such as the lymphatic, thyroid, spleen, tonsils, and adenoids.

The PITUITARY GLAND, which is about the size of a pea, is a kind of appendage of the brain, and lies concealed in a bony chamber at the base of the skull. It is an important gland under the control of the sympathetic nervous system, and has been described as the leader of the endocrine orchestra. It consists of two parts, an anterior lobe and a posterior lobe. Two hormones have been isolated from the anterior lobe, one of which has the function of controlling the rate of growth, whilst the other is concerned with sexual development. These hormones are considered to be antagonistic in action, and the reason why the development of the sexual functions is deferred until the age of puberty is probably because in childhood the growth hormone predominates over the sex hormone.

The posterior lobe of the gland also secretes two hormones, one having the power of stimulating unstriped muscles, particularly the uterus, whilst the other has a powerful effect on the vasomotor system, causing the blood pressure to be increased. This lobe also exerts some control over the metabolism of fats and carbohydrates.

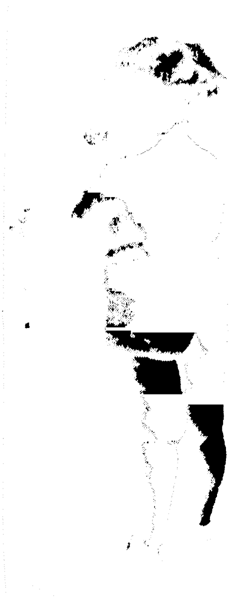


FIG 10. *Adiposity due to Abnormal Pituitary Action.*

In consequence of these various activities of the pituitary hormones, it is not surprising that when this gland becomes disordered the symptoms produced may be very varied.

Thus in children in whom the epiphyses of the long bones have not yet joined up, if the growth hormone is produced in excess, the result is that considerable overgrowth of the bones occurs, and the condition known as gigantism is produced. The giants seen in travelling shows have had, in all probability, from early childhood, disordered pituitary glands. If the condition occurs in later life when the epiphyses of the bones have already joined up, the disease known as acromegaly results, overgrowth of the long bones and skull occur, but without producing gigantism. Similarly, a deficient secretion of this hormone is associated with certain forms of dwarfing.

In other instances in children, sexual development may be prematurely advanced or suppressed, sometimes along with abnormal deposition of fat on the body (Fig. 10).

The two SUPRARENAL or ADRENAL GLANDS, as they are also termed, are small ductless glands situated just above the top of each kidney. Their structure shows two distinct parts, the outer one being known as the cortex, and the inner one the medulla, the former secreting a hormone whose function is to control the onset of sexual characteristics, while the latter secretes a powerful hormone called *adrenalin*, the effect of which is to stimulate the activities of the sympathetic nervous system when additional effort is required. In times of vital emergency in preparation for conflict or flight, an extra amount of adrenalin enters the blood stream, with the result that the liver by converting its glycogen is enabled to keep the blood constantly supplied with sugar for the purpose of nourishing the muscles. The circulation of the blood is speeded up and diverted to the muscles rather than the viscera : if bleeding occurs, the blood is clotted more rapidly and the vessels contracted to minimize the loss of blood.

It has been discovered that the PANCREAS, in addition to secreting pancreatic juice, which is conveyed by a duct from the gland to the small intestine, also contains certain groups of cells which have been termed islands, which secrete a hormone called *Insulin*. Insulin is very important in the metabolism of sugar and assists muscles and other tissues to assimilate sugar from the blood. When the hormone is deficient the assimilation of sugar is interfered with and consequently an excess of sugar accumulates in the blood. This is what occurs in the disease known as diabetes, and in the modern treatment of this disease insulin made from the pancreas of sheep or cattle is successfully employed.

The PINEAL GLAND is a small body situated in the upper part of the brain. By some it is regarded as the rudiments of a third eye, similar to that which is found in this position in certain of the lower vertebrates. By others it is considered that the secretion of this gland exerts a restraining influence on the development of the sex organs, and evidence in support of this is afforded by the fact that in some cases of precocious puberty the gland has been found to be diseased.

There are certain cells in the TESTES and OVARIES which secrete hormones, the functions of which are to bring about the secondary sex characteristics which occur at puberty, such as the development of hair in various parts of the body, the breaking of the voice in the case of the male, and the development of the breasts in the female.

It would appear that in health there is a definite interaction between the activities of the various ductless glands and a constant balance established between the various endocrine secretions, but when this balance is upset to any marked extent by a special increased or decreased secretion of one or more of these hormones, one or other of the conditions described results. It is also highly probable that different relative proportions of the respective hormones in the circulation have an important bearing upon individual characters, general dispositions, emotions or temperaments, and passing moods of irritability, temper, elation, and depression, etc., are in all probability due to endocrine disturbances.

CHAPTER 3

WELFARE OF INFANTS AND YOUNG CHILDREN

Infant Mortality, its causes and prevention. Maternity and Child Welfare Schemes. Types of Clinics. Work of Health Visitors. Day Nurseries. Nursery Schools and Classes. The Training of Elder Girls in Mothercraft.

PUBLIC Health legislation during the latter part of the 19th century was concentrated almost entirely upon the improvement in such environmental conditions as drainage, water supply, and, in particular, the closing and demolition of insanitary houses. In many of the towns there were overcrowded and ill-ventilated court houses, with insufficient water supply, and often only one common W.C. for all the occupants of the court. Under such conditions it was not surprising to find that the occupants and their clothing were often filthy, that improvidence and intemperance were rife, and that not only was the general mortality rate excessively high, but that a heavy toll of infant life was also being exacted.

Legislation attempted from time to time to remedy such social evils, but experience showed that attending to environmental conditions alone did not result in that reduction of the excessive number of deaths amongst infants which had been expected. Early in the present century, therefore, an intensive study of the problems concerning maternity and child welfare was commenced.

The term INFANT MORTALITY, as commonly used, means the death of infants under one year of age, and is conveniently expressed as a rate known as the *Infant Mortality Rate,* which is calculated by multiplying the number of deaths of children under one year of age in the district by 1,000 and dividing by the number of children born alive in the same area during the same year, *e.g.* if there were in a town 9,000 live births during a given year, and 720 infants under 12 months old died during the same year, the Infant Mortality rate would be calculated thus: $\frac{720 \times 1000}{9000} = 80$. This rate is useful for comparison between different towns and between different areas of the same town, and its rise or fall from year to year is a useful index of the success or failure of whatever Public Health measures have been adopted in attempting to reduce the rate.

Since the commencement of the century the Infant Mortality rate for England and Wales as a whole has dropped from over 150 to a figure less than one half of this. As might be expected, the figure is higher in industrial areas than in rural and residential areas.

The *Causes of Infant Mortality* are complex, the most important being congenital defects and premature birth, wasting diseases, respiratory affections such as pneumonia or bronchitis, and digestive disturbances, in particular diarrhœa and enteritis.

Poverty is not a cause of high mortality, it having been shown by social investigations that the infant mortality in areas where poverty is associated with a natural and hygienic mode of life contrasts favourably with the infant mortality in those congested and industrial areas, where, though wages may be higher, conditions are less sanitary, and, as often happens, the children are weaned too soon and may be transferred to the care of incompetent hands.

As it is recognized that some of the causes responsible for infant mortality are consequent upon conditions caused by the ill-health of the expectant mothers, steps are now being taken to care for the health of expectant as well as nursing mothers.

The following is a brief summary of the main provisions of the various *Acts dealing with Maternity and Child Welfare* :—

In 1907 the Notification of Births Act was passed as an adoptive act, though later, in 1915, it was made compulsory for local authorities to put this Act into force. It imposed the duty on the father or any person in attendance upon the mother to inform the Medical Officer of Health in writing within 36 hours of the birth of any child, whether born alive or dead. By the passing of the Notification of Births (Extension) Act, 1915, local authorities were empowered to undertake child welfare activities, and Government Grants were made available for the organization of welfare centres, both for infants and expectant mothers, the appointment of health visitors to attend at the clinics and visit in the homes, and payments to doctors attending on confinements, to midwives, and for the treatment of the mothers in hospital.

By the Maternity and Child Welfare Act of 1918, local authorities were permitted to make arrangements to safeguard the health of children under school age, and thereby enable the gap in the supervision of children between infancy and five years of age to be filled. These Acts have now been repealed and their provisions included in the Public Health Act, 1936.

Under the various provisions referred to, local authorities are given considerable powers for the development of

MATERNITY AND CHILD WELFARE SCHEMES

A satisfactory scheme would provide the following :—

(1) Ante-natal and post-natal clinics.

(2) The home visitation of expectant mothers by health visitors.

(3) Beds in a maternity hospital for the treatment of any complication arising during pregnancy.

(4) The supervision of all practising midwives.

(5) Skilled assistance during confinements at home.

(6) Beds in a maternity hospital for cases of difficult confinements.

(7) Child welfare and toddlers' clinics.

(8) Dental treatment for mothers and pre-school children.

(9) The periodical home visitation by health visitors of ante-natal mothers, infants and pre-school children.

In connection with the work of Maternity and Child Welfare schemes an adequate staff of properly trained *Health Visitors* is essential, and regulations dealing with their qualifications and training have been made by the Board of Education and the Ministry of Health, with the object of securing that they shall have adequate knowledge and experience of the work required.

Health visitors are required to be registered nurses, to hold the Certificate of the Central Midwives Board, and to have the Health Visitor's Certificate of the Royal Sanitary Institute.

The duties of health visitors include :—

The home visitation of expectant mothers who have previously attended at the ante-natal clinics, or have been referred by private doctors, and of infants and young children, and the making of necessary enquiries with regard to still-births and deaths of infants, and assisting in the work of the ante-natal and child welfare clinics. Sometimes the duties of health visitors are combined with those of school nurses or tuberculosis nurses.

ANTE-NATAL CLINICS were inaugurated with the dual object of safeguarding the health of expectant mothers during pregnancy, and of endeavouring to ensure that the children shall be born in a healthy condition. The clinics are placed under the charge of doctors with special experience in obstetrics and child care.

At the first visit of an expectant mother to the clinic a thorough examination is made and she is instructed as to the proper regimen to be carried out, and is advised to keep under the regular medical supervision of the clinic doctor, or of her own doctor. At subsequent visits she is given instruction in hygiene, the preparation for confinement, the importance and management of breast-feeding, the making of infant's garments, the provision of a suitable cot, and in the care of young infants. If thought necessary, the health visitor pays visits to the home.

Some authorities have established their own Lying-in Hospitals, to which cases can be admitted where difficulties have arisen, or are anticipated, or where the home conditions are unsatisfactory or inconvenient.

In some 50 per cent. of maternity cases the mothers are attended solely by midwives, and in view of the fact that formerly many of the women who acted as midwives were ignorant, careless and untrained, the Midwives Acts of 1902, 1918, 1926, and 1936 were passed, with the object of improving the qualifications of those permitted to practise as midwives. These Acts required all midwives to be registered, and laid down the standard of training and amount of knowledge required for the certificate of the Central Midwives Board, which is necessary before registration. The Act of 1936 requires local authorities to employ an adequate number of midwives and maternity nurses.

When a woman is to be confined at home the authority should make arrangements to ensure that a suitable maternity outfit is available, that a midwife shall be in attendance, and that the services of a doctor shall be available if the midwife consider this desirable.

The authority has the power to pay part or all of the cost of such skilled attention. Sometimes a " home-help " to look after the house during the period of confinement is also provided by the authority.

When the confinement is over and the midwife has ceased attending, the health visitor calls to see the mother and advises her as to the best method of keeping herself and the baby in good health, and also, if she cannot afford a private

FIG. 11. *A Demonstration to Mothers at a Child Welfare Clinic.*

doctor, to attend with her baby at one of the child welfare clinics as soon as she is able to get about again. From time to time during the first year the health visitor should visit the home, the frequency of such visits depending upon the conditions found. Subsequent visits should be made at gradually increasing intervals, until the child is of school age.

CHILD WELFARE CLINICS may be provided by the local authorities or by voluntary associations and are usually located in houses or halls adapted for the purpose, but specially built premises are preferable.

The clinic premises should include a pram shed, a waiting room, weighing room, interviewing room, doctor's room and dispensary, together with the necessary offices. In some clinics a large room is also provided which can be used for lectures and demonstrations on health, cookery, sewing, etc. At some child welfare centres arrangements are made for the in-patient treatment of a few infants who are not making satisfactory progress.

These clinics are in the charge of specially experienced medical officers, who are assisted by health visitors, and sometimes by voluntary helpers.

On the first visit to the clinic all new cases are examined by the doctor, but subsequently the health visitor usually selects which babies should be seen. On each occasion that the babies are taken to the clinic they are weighed, in order to note whether they are making satisfactory progress.

The clinics are not intended to be places where medical treatment will be prescribed: their main purpose is the diagnosis of infantile ailments and the education of the mothers in mothercraft. When the infant is not making the proper progress, the question of the suitability of the mother's and infant's diet is investigated and advice given, and certain foods, such as liquid and dried milk and malt and cod liver oil, if required, can be purchased at the dispensary at, or below cost price.

In actual practice only a small proportion of the children

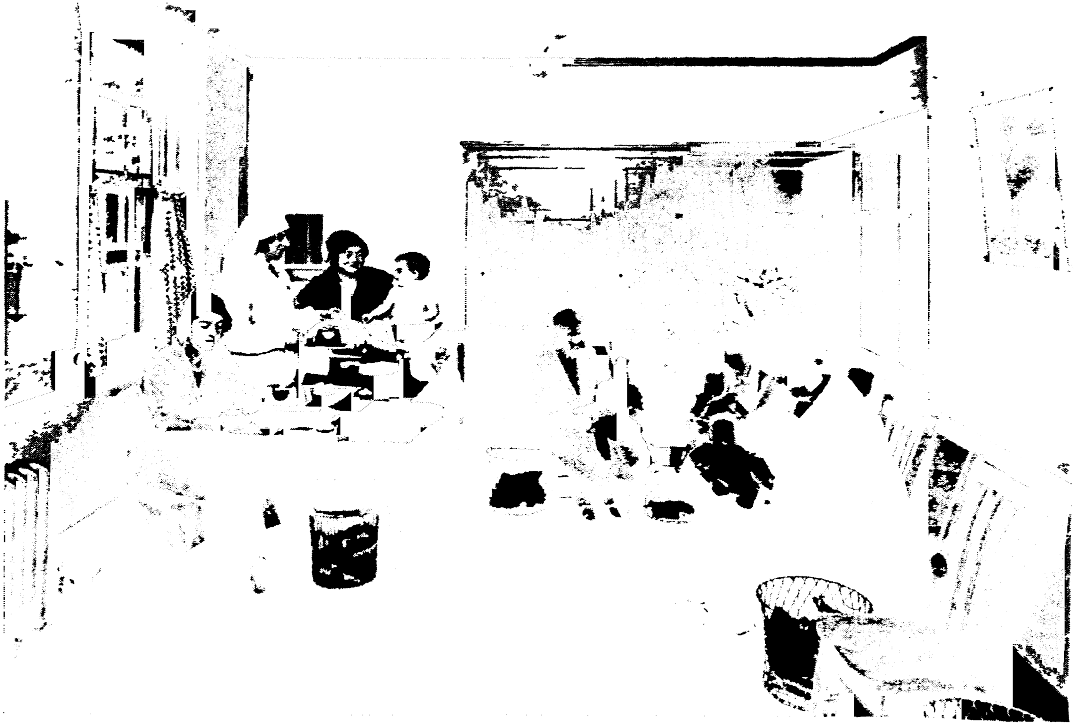


FIG. 12. *The Weighing Room at a Child Welfare Clinic.*

(Photo kindly supplied by the Medical Officer of Health, Birkenhead.)

are brought to the clinics after they have attained the age of two, and many cease to be brought after the first year. A few authorities have provided special " toddlers' clinics " for children of 2 to 5. These children are usually summoned quarterly for medical examination.

That much more might be done by this service in the prevention and early remedy of defects, is evidenced by the findings of school medical officers at their examination of children on entry into school. An ideal child welfare scheme should permit of the following up of all suitable cases until their admission to school, and also provide facilities for the treatment of such conditions as rickets, enlarged tonsils, adenoids, defective eyesight, running ears, deformities, dental defects, etc.

Duplication by an authority of specialized treatment centres for such defects is both unnecessary and uneconomical, and such clinics as are provided should therefore be made available both for school children and pre-school children.

DAY NURSERIES. In some areas Day Nurseries have been established at which mothers who have to go out to work may, for a small charge, leave their children for the day. Generally speaking, it is not desirable that infants under nine months of age should be admitted to day nurseries, whilst children of three years of age or over should preferably be admitted to a nursery school, if one be available. Day nurseries were originally founded as the result of voluntary effort, but since 1914 the Board of Education have given grants towards their maintenance; in 1919 their control was transferred to the Ministry of Health.

At the present time there are not many day nurseries in the country, and of these the great majority have been provided by voluntary agencies.

The accommodation at a day nursery is normally for some 30 to 35 children, though, under exceptional circumstances, provision for as many as 50 children might be permitted.

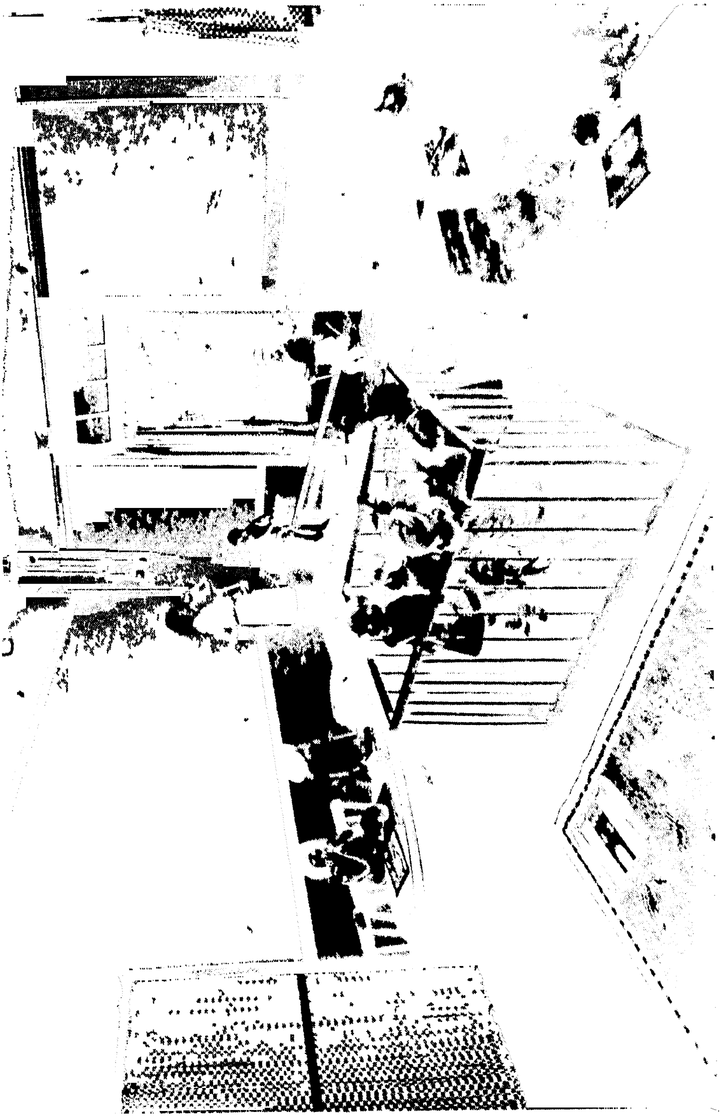


FIG. 13. *A Day Nursery.*

(Photo kindly supplied by the Medical Officer of Health, Birkenhead.)

Each nursery is in charge of a matron, who should preferably be a trained nurse, and she is assisted by a staff of probationer nurses who bathe, feed, and tend the children. Every child, each day on admission, should be carefully examined for signs of any infectious or contagious disease, and in this connection a room should be available for isolation purposes. Unfortunately these nurseries prove costly to maintain, and this is the reason why so few are in existence. Writing on this subject, Sir George Newman has stated that it would be advantageous if day nurseries could be combined with nursery schools, so as to provide accommodation for all children under school age. By this means some of the less satisfactory features of existing day nurseries, such as the employment of an inadequately qualified staff and the absence of systematic training for any older children admitted could be removed; likewise, some of the expense and "educational" regulations of the nursery school could be removed. The value of a simple institution of the kind proposed would be far higher if its functions were not divided, as now.

NURSERY SCHOOLS

In the poorer quarters of the larger towns many of the children are handicapped by their environment, and this handicap has been intensified by the shortage of houses, which has necessitated a great number of families having to live in overcrowded conditions in sublet dwellings. In other cases the handicap is due to certain domestic difficulties, as for example, where the mother is ill or has to go out to work, and the child cannot receive proper maternal care.

The late Margaret McMillan, a few years before the war, recognizing the particular handicaps of the younger children in the poorer districts, opened at Deptford, one of the poorest districts of London, what she called a Nursery School, to which children of the neighbourhood, of the ages of 2 to 5, were admitted. The great success which resulted from her experiment has led to the establishment of similar nursery schools in other parts of the country. In the Education Act of 1921, power is given to local authorities to provide nursery schools or to assist voluntary agencies in maintaining such schools.

In 1933 there were 62 such schools recognized by the Board of Education, of which 28 were opened and maintained by voluntary agencies. These schools constitute an important link between the Infant Welfare and School Medical Services.

A nursery school is an independent unit, neither associated with any public elementary school nor controlled by its regulations. The school, to which children between the ages of 2 and 5 years are admitted, may be established either in a building specially built for the purpose, or in an adapted building.

The school should have a southern aspect, be large and airy, and provide not less than 12 to 15 square feet per child, though some schools allow nearly double this amount.

The classrooms should be of the open-air type, with large windows on both the North and South sides, as *e.g.* those of the Esavian type, which are capable of being widely opened. Adjacent classrooms, which may serve also as dining, play and rest rooms, should, for this reason, be separated by sliding partitions only. Some method of heating the classrooms must be provided so as to allow of the temperature being maintained at between 50° and 60° F., the best arrangement, though somewhat expensive, being to have hot-water pipes running under the floors or behind the panelling of the walls.

The floors should have an easily washable surface, which can perhaps best be secured by having a covering of linoleum. It is an advantage to have on one of the sides of the classrooms, preferably the North, a glass-roofed verandah about 6 feet wide.

Ideally, the school should be divided ino units of 40 children per class, each class having its own cloakroom, W.C.s, lavatory, containing wash-bowls, slipper and spray bath, a generous supply of hot and cold water being provided. In the cloakroom the pegs should be arranged 12 inches apart, and there should be provided facilities for drying clothes and shoes.

Each child should have its own equipment, consisting of stretcher bed, washable rug, towel, face flannel, toothbrush, comb, and overall, whilst it is very desirable that slippers should be provided for wear while wet shoes are being dried. The classroom should be furnished with light tables and chairs so that they can be moved by the children themselves when required. The stretcher beds must be light and of the collapsible type with a sailcloth base, over which is slipped two sheets sewn together at their sides, as it is found that the sailcloth gets very dirty if left uncovered. The covering sheet can be easily washed, and by turning it round weekly, made to last a fortnight.

Usually three meals are provided, breakfast, dinner, and tea, the breakfast consisting of porridge, bread and butter or dripping, and cocoa. Milk is served in the middle of the morning, and a two-course dinner given at noon. Tea is a light meal of bread and butter with jam or cake, and milk or cocoa. Cod liver oil and malt may be given on the recommendation of the school medical officer.

Although the daily routine naturally varies in different schools, a typical day's programme would be somewhat like the following :—

The children, on arrival at about 8·30, would have their personal hygiene attended to first, such as changing shoes, cleaning teeth, washing hands, etc., and this would be followed by breakfast and habit supervision. During the morning the children would be allowed to play, be told stories, given instruction in correct speech, etc., and encouraged to take an interest in flowers, animals, and music. After the mid-day dinner the children would be required

FIG 14. *Toothbrush Drill at a Nursery School.*

(By permission of Photopress, Ltd.)

to sleep on their folding beds. The afternoon would be occupied in a similar manner to the morning, the children leaving for home about 5·30.

Under the Regulations of the Board of Education no charge may be made except for food or medical treatment.

The medical side of the work is carried out by the school medical staff, and arrangements should be made for any previous medical records of the children which the Maternity and Child Welfare Department may have, to be handed on to the school. In the different areas the medical officer's visits vary from as frequently as once a fortnight to once a term, but the head mistress should always be in a position to ask for a special visit of the medical officer should occasion arise. A school nurse should, if possible, visit the school daily, for the purpose of making health inspection, taking temperatures when necessary, and dealing with minor ailments.

In a few areas NURSERY CLASSES have been established, and these are cheaper to maintain than nursery schools, from which they differ in not being self-contained, but administered in association with a public elementary school, and under the supervision of the Head Mistress of the Infants' department. These nursery classes do not admit children under three years of age, since they are conducted under the regulations controlling public elementary schools, which do not permit the admission of children under the age of three. Meals are not provided, and the children arrive later and leave earlier than in the case of the nursery school children. As these classes are usually located in the older type of school buildings, suitable classrooms are seldom available, washing facilities are frequently unsuitable, bathing facilities non-existent, the floor space is limited, and there is rarely a garden. There is a tendency for the children's activities to be restricted in order to prevent interference with the ordinary infants' school pupils, whose work also may be affected in the endeavour not to disturb the nursery class during rest periods.

NURSERY SCHOOLS ATTACHED TO INFANTS' DEPARTMENTS are a new development in Bradford, where nursery schools have been built on the sites of infants' schools in cases in which the elementary school site is large enough. The Head Mistress of the Infants' school is then available to take charge.

THE TEACHING OF MOTHERCRAFT

MOTHERCRAFT is a term applied to the knowledge and skill required to enable a mother so to bring up her children that they will have every chance of developing into healthy and useful citizens.

It is wrong to assume that the human mother instinctively knows best how to bring up her children. On the contrary, it has been due largely to such lack of knowledge of mothercraft that the Infant Mortality rate has in the past been so excessively high.

In an endeavour to counteract this ignorance local authorities inaugurated Child Welfare schemes, under which were established the clinics already mentioned, where advice could be obtained, and steps taken to instruct the mothers in mothercraft.

But no matter how well planned or organized such schemes may be, it by no means follows that all mothers will appreciate the value of attending these clinics, an attitude of mind largely due to ignorance.

Teachers can be of material assistance in preventing the development of such an attitude of mind in the case of the future mothers, by instilling into the minds of older girls an interest in the elements of mothercraft.

In addition to the cooking, laundry, and housewifery instruction which the older girls receive at school, the more progressive schools are now including some training in the care of infants and young children.

One advantage of such teaching will be that an interest will be aroused, and what has been learnt at school will prove of much value to the girls should they eventually become mothers, and in addition they will then be more likely to welcome the expert advice and assistance of the child welfare staff.

Such classes are taken in some cases by the Head Mistress, in others by a teacher with special knowledge and training, and arrangements are sometimes made for lectures to be given by one of the health visitors or school nurses. Naturally the lines on which such a class is conducted will vary somewhat according to local conditions.

Such a course of instruction would begin with simple general hygiene, and in schools where elementary physiology is taught, would include some knowledge of the structure of the human body, this knowledge having been acquired gradually through lessons advancing from the description of some simple forms of plant and animal life to the more complex physiology of the higher animals.

When the physiology of the human body has been dealt with, lessons should be given on the proper feeding, clothing, and bathing of infants, the amount of sleep required, and the training in good and regular habits. The benefits derived from fresh air and sunshine and early bedtime, and the evil results following infringements of the rules of health should be emphasized.

The bathing, dressing and undressing of an infant may be demonstrated and practised by using a life-sized doll, the bath being prepared and the temperature of the water being tested by the girl whose turn it is to look after the baby. The clothing required may be made by the girls themselves in the needlework class.

In a few of the more recently erected schools a furnished flat has been included, and two or three of the senior girls in turn are placed in charge of it for a few days at a time under the supervision of a teacher.

They are required to draw up the weekly budget, carry out all the work to be done in the flat on the various days, purchase the food and cook the meals, lay the table, and wash up after the meals.

If the school be situated near a Day Nursery or Infant Welfare Centre, it is a very good arrangement for the girls to be taken there to see what they have learnt being put into actual practice.

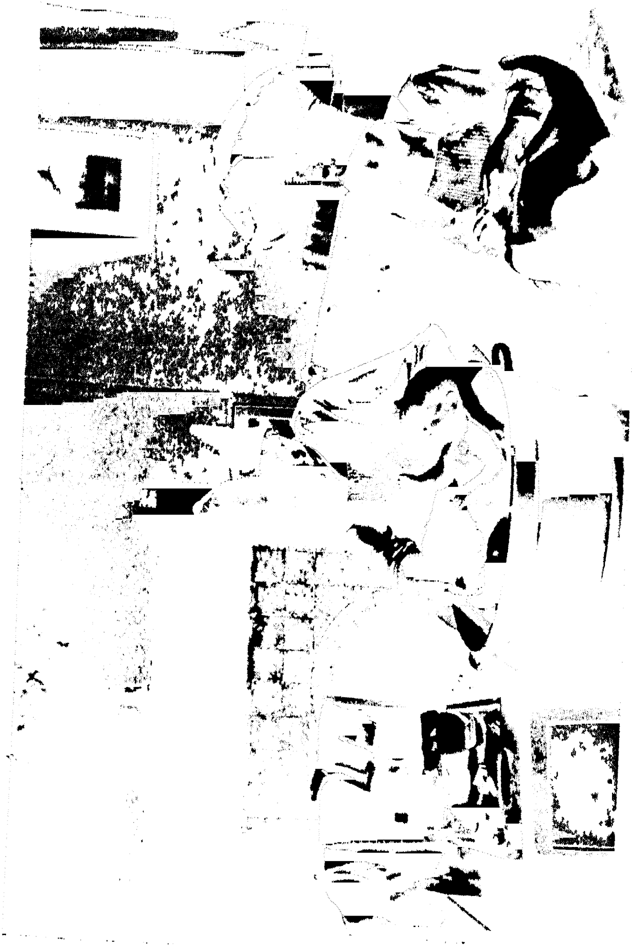


FIG. 15 *Learning to look after "Baby" at a Domestic Science Centre.*

(From 'The Schools at Work' by kind permission of Messrs Evans Bros Ltd)

CHAPTER 4

AIR, VENTILATION AND SUNLIGHT

The composition of Air. Principles and methods of Ventilation. Leonard Hill's experiments. The Kata-thermometer. Examples of natural and artificial mthods of Ventilation. Natural and Artificial Sunlight.

AIR

THE air which surrounds the earth to a height of some miles is a mixture of gases, the average percentage composition by volume at sea level being as follows: Oxygen, 20·94; Nitrogen, 78·09; Argon, 0·94; Carbon dioxide, 0·03. There is always also a varying amount of water vapour present, whilst in the air of towns various chemical vapours produced by factories are found, and near the sea traces of ozone occur. Air also contains solid particles in the form of dust, which is composed of both mineral and organic matters, such as grit, fragments of plant fibres, bacteria, and smoke, which mainly consists of small particles of unconsumed fuel. The presence of smoke in the air is responsible for the blackening of stone buildings and for causing fogs, and it is deleterious to health, owing to the fact that it causes irritation to the lungs, and moreover, cuts off considerably the ultra-violet rays of the sun. Though required for plant life, the nitrogen gas is quite inert so far as the respiration of animals is concerned, but it serves to dilute the oxygen to a proportion suitable for satisfactory respiration. So far as is known argon has no physiological value. If the amount of oxygen in the air be reduced to some 11 or 12 per cent. the air becomes dangerous to life, whilst if there is less than 7 per cent. life cannot be sustained.

Carbon dioxide in the atmosphere is produced by the combustion of fuels, the oxidation of organic matters, and also by respiration, expired air containing about 5 per cent. of this gas. Plants absorb carbon dioxide from the air and break it up into carbon, which they utilize for growth, and oxygen, which is set free into the air.

Normally the body, which is constantly generating heat, is kept at a temperature of 98·4° Fahrenheit, the mechanism for maintaining this fixed temperature being governed by the heat regulating centre in the brain. Body heat is lost through the medium of the skin by radiation, convection, and conduction.

Radiation is the transmission of heat by means of waves, which warm any objects they strike, without appreciably heating the medium, such as the air, through which they may pass, as in the case of the radiation of the sun's heat rays or those from a stove, fire or radiator. As the average temperature of rooms is approximately 60° F., which is much lower than the temperature of the surface of the body, a considerable amount of heat is being constantly radiated from the body. About half the heat lost from the body is radiated in this manner. Heat is also lost through the skin by means of the evaporation of perspiration which is constantly taking place. Although the great majority of the heat lost is through the skin, a proportion is also lost by the breathing out of warm air and by the excretions.

Convection is the term applied to the transmission of heat in a gas or a liquid, and is brought about as the result of individual particles of the gas or liquid being heated and then expanding and thus becoming less dense and so being caused to rise, whilst the cooler and denser particles descend to take their place and these in turn get heated and move on. The heat lost by the body by convection is considerably increased when the air in contact with the body is in motion. *Conduction* is the transference of heat through solids from particle to particle, without any change occurring in the relative positions of such particles. Body heat is lost by conduction through the clothing.

VENTILATION

VENTILATION may be defined as a process whereby fresh air is caused to pass through any enclosed space, such as factories, dwellings or schoolrooms, for the purpose of removing heated air and the products of combustion and respiration, and replacing them with fresh air.

Poorly ventilated premises adversely affect the health of the occupants. Occasional exposure to a vitiated atmosphere, such as occurs in crowded and ill-ventilated halls, causes headache, lassitude, yawning, clamminess of the skin, and a feeling of faintness.

More constant exposure to such atmospheres, as in the case of regularly sleeping in overcrowded bedrooms with the windows closed, sitting in overheated and ill-ventilated classrooms, working in stuffy workrooms, produces anæmia and a lowering of the general health and predisposes to catarrhal conditions of the respiratory tract (colds, bronchitis, tuberculosis, etc.), impairment of mental activity, and a diminution in the quality and quantity of the work being undertaken. In the case of schools, infectious disease spreads much more rapidly in classrooms where the ventilation is inadequate than in classrooms ventilated on open-air principles.

At the beginning of the present century Professor Flügge conducted certain experiments at the Institute of Hygiene, in Breslau, on the physical effects of ventilation, and these experiments were later extended by Professor Leonard Hill in this country, and as a result of the latter's brilliant work both the theory and practice of ventilation have been considerably revised.

It was formerly considered that the ill-effects of deficient ventilation were attributable to a diminution of the amount of oxygen, an increase in the percentage of carbon dioxide, and to some mysterious organic poison which was assumed to be exhaled from the lungs.

With regard to the diminution of oxygen, it had been found that in crowded premises, such as in the pit of a theatre, the percentage of oxygen was never reduced by more than about 1 per cent., whilst in the Alpine health resorts the diminution of oxygen in the air was often still more. As Leonard Hill pointed out, it is quite clear that this cause is not responsible for the ill-effects of poor ventilation, since a very slight increase in the number of respirations taken per minute would easily compensate for such a slight oxygen content deficiency in the air.

Investigations with regard to the effects of an increase in the carbon dioxide content in the air showed that this also is not the responsible cause, *e.g.* it was found that this gas was often present in the atmosphere of rooms in breweries and aerated water manufactories to an extent far in excess of that ever occurring in the worst ventilated rooms, without causing any ill-effects to the workers.

One of *Leonard Hill's experiments* was as follows: A wooden air-tight chamber was constructed having observation windows, and arrangements were made to enable the temperature of the chamber to be raised by means of electric radiators, or cooled by circulating cold water through coils of pipes. The percentage of water vapour within could be increased by placing vessels of water over the heaters. The chamber was also fitted with electric fans for the purpose of setting in motion the air within, without the admission of any air from outside.

Into this experimental chamber some students entered, laughing and joking, and when the oxygen content fell to about 17 per cent., they found to their surprise they were unable to ignite their matches to light their cigarettes. The carbon dioxide content went up to some 3 or 4 per cent., the temperature rose, and the percentage of water vapour increased. The students ceased their joking and later also their talking, their faces becoming flushed and moist.

By means of a facepiece connected with a tube leading outside, one of the students inside was enabled to breathe fresh air, but this afforded him no relief; on the other hand by a similar arrangement a student outside the chamber breathed air from within, and did not experience any adverse effect. The fans within the chamber were then set in motion, and the discomfort of the occupants was at once greatly relieved, the improvement being sustained so long as the fans were kept moving, and this, despite the fact that the oxygen content had been reduced to some 16 per cent., and the carbon dioxide increased to some 3 or 4 per cent.

This experiment showed that the ill-effects arising from deficient ventilation were not due to the altered proportions of oxygen and carbon dioxide in the air, nor to the formerly assumed organic poison present in expired air, but to the raised temperature and increased moisture of the air, and most important of all to the lack of movement in the air.

Normally the body, which is constantly generating heat, has any excess of heat dissipated mainly by direct radiation, and partly also by conduction to the clothing which comes into contact with the skin, this loss of heat being considerably assisted by convection when there are moving currents of air. When these means are not sufficient to get rid of the excess of heat, the cooling of the body is assisted by the evaporation of sweat from the skin, because body heat is extracted in the process of evaporating the sweat. When, however, the atmosphere is humid very little evaporation occurs and its cooling effect is almost negligible.

In view of the importance of the physical properties of the air in connection with ventilation, Leonard Hill devised a special thermometer which he termed the *Kata-thermometer*, which is an instrument for measuring the cooling power of the air. In construction it is a thermometer containing alcohol instead of the usual mercury, and having at the top of the stem a small expansion of the bore. There are only two graduation marks, one near the top of the stem and the other three-quarters of the way down; the upper mark registering a temperature of 100° F. and the lower 95° F. In using the instrument, the bulb is inserted into hot, not boiling, water until some of the alcohol has been driven up the stem into the upper expansion. The bulb is then withdrawn and wiped dry, and the thermometer suspended in the air to be tested, and as it cools the alcohol begins to descend again, and, with a stop watch, the time is taken for the instrument to cool from the upper mark on the stem to the lower mark, the time taken being dependent upon the temperature of the air and the degree of air movement taking place.

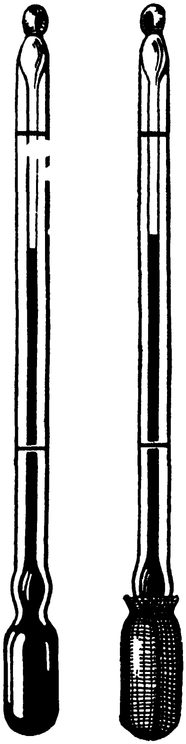


FIG. 16.
The Kata-thermometer. (*From Currie's "Textbook of Hygiene," by permission of Messrs. E. & S. Livingstone, Edinburgh.*

With each instrument the makers supply a factor, which is engraved on its stem, and which, when divided by the time in seconds taken by the alcohol in falling from the upper to the lower mark, gives what is known as the dry Kata reading, or DK, and is an index of the cooling power of the air. For example, if the time taken for the alcohol to drop between the two marks was 60 seconds, and the factor for the particular instrument in use was 480, the DK reading would be $\frac{480}{60} = 8$.

The dry Kata reading is the measure of the amount of cooling which is going on as the result of the processes of radiation and convection. It is considered that for indoor life and sedentary work a DK of 6 is the most comfortable, a smaller figure implying that the cooling conditions are inadequate, and the higher reading that the cooling of the body is taking place too rapidly.

But in addition to the cooling due to convection and radiation, it is equally important to know what amount of cooling is going on as the result of evaporation, and this can also be ascertained by the Kata-thermometer.

The instrument, which for this purpose has its bulb covered with a lisle thread cap, is inserted in hot water as before, and after taking it out the excess of moisture is removed from the base of the cap as it accumulates, and the reading and calculations are made in the same manner as previously. The result, which is known as the wet Kata reading or WK, gives the cooling power of the air due to the combined efforts of radiation, convection and evaporation. The cooling effect attributable to evaporation alone can be ascertained by subtracting the DK from the WK reading. When room temperatures are high, cooling by radiation and convection are naturally limited, so that the efficiency of ventilation depends largely upon the amount of evaporation taking place.

Children require a greater cooling power of the air than adults, and in schools it is preferable that the atmospheric conditions should be such as to give a DK reading not less than 7, and a WK reading of over 20.

Dr. Simpson has carried out some interesting investigations with the Kata-thermometer in different types of schools, and found that the cooling power in artificially ventilated schools (plenum type) was very deficient and compared unfavourably with schools ventilated by open windows. Good results could, however, be obtained even in the older types of schools, provided that they had plenty of open windows, and he also showed that considerable improvement resulted in the physical condition of the atmosphere if all the doors and windows were open during the play time intervals.

Needless to say very good readings were obtained in schools built on open-air principles.

Leonard Hill has shown that air stagnation has a definite adverse effect upon the feeling of well-being, and that it exerts an influence upon the prevalence of certain illnesses. He further pointed out that respiratory infections were largely attributable to undue moist, heated indoor conditions. He states that " when children after the holidays return to school, epidemics of ‘ colds ’ usually begin to run through the community. In the holidays they may paddle all day in the sea, go barelegged and exposed to far greater cooling than at school, they may shiver and be blue with cold after bathing ; they do not suffer from ‘ colds ’ then. The colds begin when the weather confines them in shut up and artificially warmed schoolrooms and places of assembly.”

When the ordinary forces of nature only are relied upon to effect the ventilation of a building, the process is spoken of as Natural Ventilation ; but when mechanical power contrivances are made use of, the method is spoken of as Artificial or Mechanical Ventilation. In the former case ventilation is effected by means of windows, doors, and chimneys. Endeavours have been made in the past to improve the ventilation of classrooms, etc., by providing such appliances as Sheringham's valves, Tobin's tubes, Cooper's discs, McKinnell's ventilators, perforated bricks, etc., but these are seldom if ever installed in modern schools.

NATURAL VENTILATION is dependent upon currents of air blowing into the room from outside and convection currents taking place in the room. Convection currents occur in occupied rooms in consequence of the heating of the air through contact with the bodies of the occupants, or by coming in contact with heated walls and furniture.

The problem of ventilation by natural methods is to secure the constant movement and frequent change of the air without creating noticeable draughts. This is best carried out by what is known as *cross-ventilation*, that is, by having windows open on two opposite sides of the room, air entering through the windows on one side passing right across the room and out through the windows on the opposite side. In order to ensure satisfactory cross-ventilation considerable attention has to be given to the types of windows installed, as well as to their number and distribution.

The following are some of the types of windows in use in connection with schools.

(1) *Sash windows.* This is the type usually found in domestic dwellings, and consists of upper and lower sash, both of which can be opened. When the upper sash only is opened, the fresh cooler air enters from outside and meets the warmer air in the room and thereby gets slightly warmed before descending. When the lower sash is opened the outside air is apt to blow directly on the occupants and to cause a draught. Such a draught can be prevented by having a deflector placed in front of the lower opening, or lessened by having a radiator beneath the window. Another method of obviating draughts from sash windows is that known as Hinckes-Bird's method, in which a piece of wood 3 or 4 inches deep is placed under the whole of the lower sash. In this way an opening is made where the upper and lower sashes overlap, and the entering air is given an upward direction and draughts thereby prevented. This method is only suitable in the case of small rooms.

A disadvantage of the sash type of window is that at the most only one half of the window area can be opened.

(2) *Hopper windows.* These are approximately 18 inches high and are hinged at their bases so that they can be opened backwards into the room. They are also usually provided with side glass cheeks which prevent currents of air escaping round the sides. In warm weather hopper windows alone do not provide sufficient ventilation and are usually employed with other types, such as the horizontally pivoted or Esavian.

(3) *Horizontally pivoted windows.* These are pivoted at the centre of the two sides so as to permit of their being swung on a horizontal axis, the upper part swinging into the room and the lower part outside.

(4) *Vertically pivoted windows.* In this form the windows are pivoted from the centres of the top and bottom of the frame, and are capable of opening and closing horizontally.

(5) *Esavian type of window.* In this variety the window, which is a wide one, is divided into vertically hinged sections which can fold on one another and allow the windows,

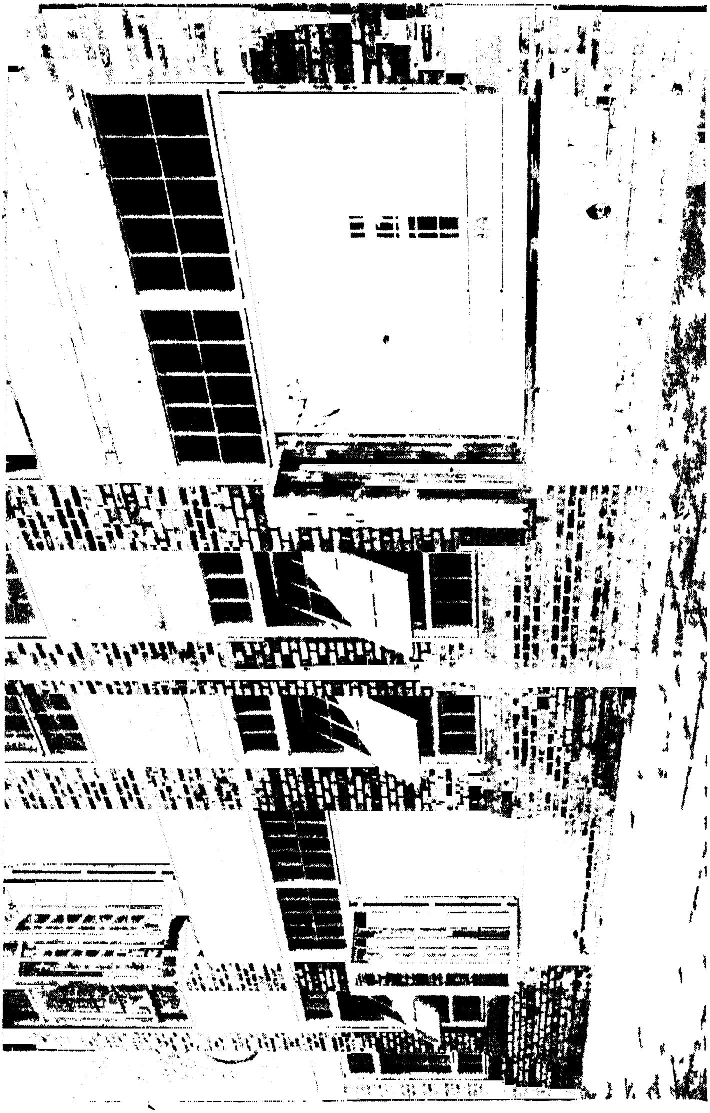


FIG. 17. *Outside View of School, showing Esavian windows, some partly and one fully opened, also horizontally-pivoted windows, under which are Hopper windows.*

which slide on a metal track on ball-bearing runners, to be partially or completely opened.

The position in which the windows are placed is of special importance, especially in the case of schoolrooms and other rooms occupied continuously for long periods.

Sometimes classrooms are built with large glazed folding doors along the whole of one side of the room, and when fully opened that side of the room is entirely exposed to the outside air. The top part of the folding doors may be hinged so as to be able to act as a hopper or fall right down, or horizontally pivoted windows may be fitted over the doors.

ARTIFICIAL OR MECHANICAL VENTILATION. For the ventilation of large buildings such as cinemas, theatres, factories, large halls, natural ventilation is seldom practicable and some form of artificial ventilation has to be relied upon. Formerly mechanical ventilation was sometimes also installed in schools, particularly those of the Central Hall type.

Broadly speaking, the systems of mechanical ventilation are of three main types.

The Extraction System. This is a type in which the vitiated air is extracted from the room or building by means of a powerful fan, fresh air entering by natural means through doors, windows, or special inlets, on the sides of the room opposite to the fans. Sometimes radiators or steam pipes are placed close to the air inlets to warm the incoming air. This extraction method is useful for narrow rooms.

The Plenum System. This is a method by which air from outside after being warmed when necessary, moistened and filtered, is forced under pressure by means of a large fan, along ducts to the various rooms of the building, the vitiated air escaping through special exhaust outlets. In this system there is no separate heating apparatus for the rooms, the warmed incoming air being relied upon also to heat the rooms. The advantages of this system are that the temperature and humidity of the air can be adjusted according to circumstances; its disadvantages from the

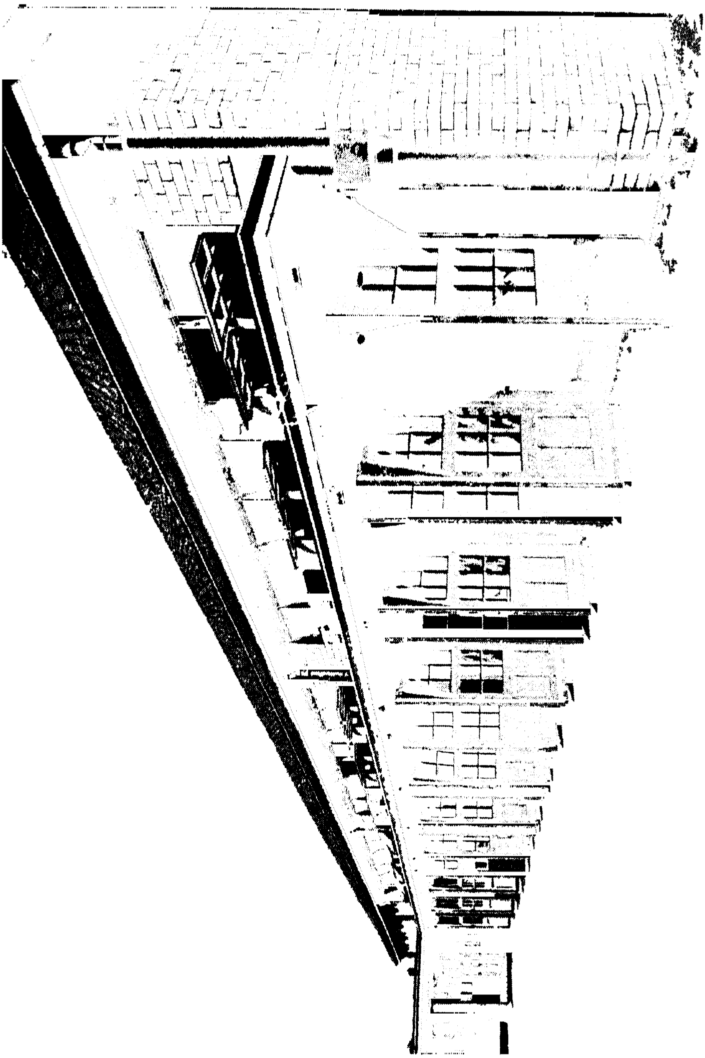


FIG. 18. *Classrooms ventilated by Folding Doors, at the top of which are Hopper Ventilators. Above the doors are horizontally-pivoted windows.*

point of view of schools are that it is expensive to instal and to maintain, the air in the rooms is monotonous, enervating, and stuffy, and as shown by experiments with the Kata-thermometer the cooling power is poor, and furthermore, as the windows have to be kept constantly closed, this is a bad practical example of ventilation to the children.

The Plenum System, combined with Extraction. In this type fans are used both for the propulsion of incoming air and the extraction of the used air. This is perhaps the most satisfactory method of mechanical ventilation.

SUNLIGHT

Animal and vegetable life as it at present exists on our earth would not be possible without the sun's rays, which consist of heat rays, light rays, and actinic rays. In passing through the earth's atmosphere a considerable proportion of these rays are absorbed, this limitation of the sun's power being of a protective nature, since if man were exposed to the full power of the rays, the heat rays would be intolerable, the light rays blinding, and the actinic rays dangerous.

In many of the industrial towns in this country, however, the protecting atmosphere becomes so laden with smoke that too large a proportion of the rays are cut off, and this deprivation of the sunlight adversely affects child life, and is responsible for much ill-health, such as malnutrition, debility, anæmia, rickets and tuberculosis.

The light rays of sunlight, which are those to which the retina is sensitive, are, as was discovered by Newton, really a mixture of what we call the seven primary colours, violet, indigo, blue, green, yellow, orange and red, a fact which can be demonstrated by passing white light through a prism of glass, which has the power of separating it into its respective components, termed the spectrum. The rainbow is caused by a similar splitting of white light into its component colours, the raindrops acting in the same manner as the prism of glass.

The colours of the spectrum are due to ether waves sent out from the sun, these waves being undulatory like the sea waves, and just as the distance between the crests of waves on the sea may vary considerably, so does the distance between the crests of the waves of the seven primary colours vary. The waves with the greatest distance between the crests are spoken of as the long waves, and those with the shortest distance between the crests are spoken of as the short waves, and the physical properties of the different waves vary according to their wave lengths.

The longest waves of the visible spectrum, when they strike the retina, produce a certain effect which the brain interprets as a sensation of red, those somewhat shorter produce the sensation of orange. and so on till we come to the shortest waves, which produce the colour sensation we call violet. Of recent years it has been discovered that the visible spectrum represents but a small portion of a very large series of ether waves of different lengths, all, with the exception of those composing white light, being invisible.

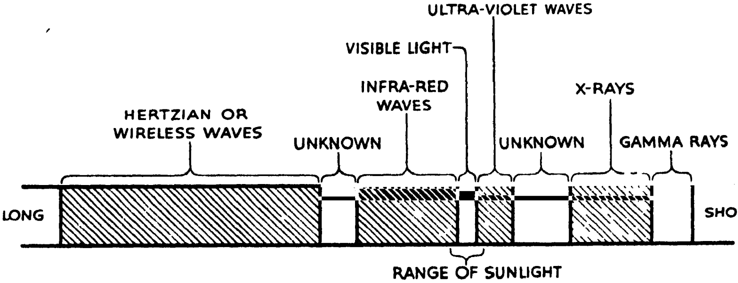


FIG. 19. *Diagrammatic representation of the range of Ether Waves of different lengths.*

Reference to the accompanying diagram shows that to the left of the visible spectrum are some waves which are longer than the red rays, and these are known as the infra-red rays. To the left of these again, and of still longer wave-length, come the Hertzian waves, which are utilized for wireless communication.

To the right of the visible spectrum, *i.e.* at the violet end, are found waves of still shorter length, called the actinic or ultra-violet rays, containing biologically active rays of great value to living tissues. To the right of these are found other waves of even shorter wave-length which have considerable penetrating power and are known as the X-rays; and there are waves of still shorter wave-length, known as the gamma rays, which are emitted by such substances as radium. It will be observed from the diagram that the radiations from the sun extend beyond the visible spectrum into the infra-red and ultra-violet areas, and further, that between the infra-red and the Hertzian waves and between the ultra-violet and the X-rays there are two bands of waves whose properties have not yet been ascertained.

The first really scientific attempt to supplement natural sunlight in the treatment of disease was made by Finsen in 1893, who successfully utilized the light obtained from an electric carbon-arc lamp in the treatment of lupus.

Dr. Rollier was the first, however, to recognize the value of scientifically regulated doses of sunlight in the treatment of disease, and he established a clinic at Leysin in Switzerland, where he secured excellent results in the treatment of tuberculous diseases of the bones and the joints.

Exposure of the skin to small doses of these rays results after a few hours in a visible reddening, and after several exposures a certain amount of pigmentation or bronzing is produced. The various skin functions are stimulated, in particular, the formation in the skin of vitamin D from ergosterol, which is essential for the utilization of calcium and phosphorus by the body in the formation of the bones and teeth. Dr. Rollier has pointed out that the diet must include foods containing an adequate supply of utilizable calcium and phosphorus. Certain effects are also produced in the blood, the numbers of red and white corpuscles, the antibodies, and amount of hæmoglobin being increased. It is also stated that the blood serum contains more calcium, phosphorus and iron salts, and for this reason, together with

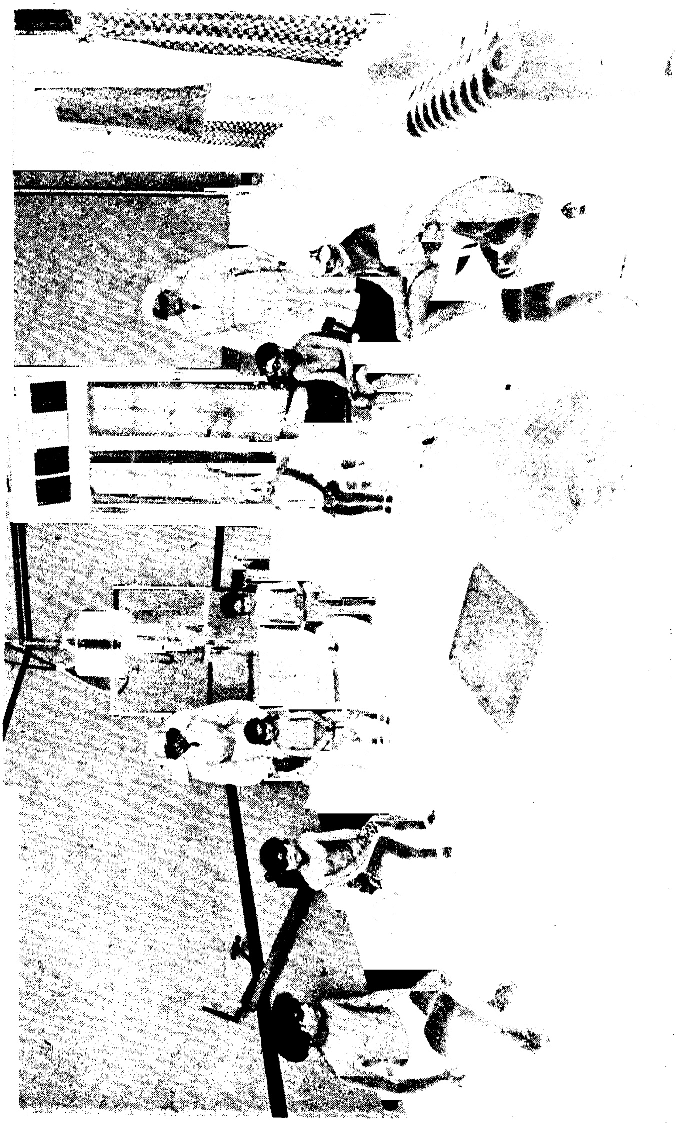


FIG. 20. *Children being treated at a School Clinic by Artificial Sunlight.*

(Photo kindly supplied by the Medical Officer of Health, Birkenhead.)

the increased vitamin D production, these rays are extensively used in the prevention and treatment of rickets.

Other important results are a general increase in the metabolism of the body, the stimulation and regulation of the hormones, and a toning up of the nervous system, resulting in increased vitality and cheerfulness.

ARTIFICIAL ULTRA-VIOLET RAYS can be produced by three types of lamps, known respectively as the mercury vapour arc, the carbon arc, and the tungsten arc. The use of ultra-violet light has proved very successful in the treatment of cases of rickets, tuberculosis, anæmia, debility, and certain nervous and skin conditions.

Considerable caution must be utilized in exposing the body both to natural and artificial sunlight, as the amount of dosage tolerated is a variable quantity, dependent upon such factors as sex (women being more susceptible than men), age, extent of the area of skin exposed, and the quality of the skin (the fair skinned, red and fair haired and freckling type being particularly susceptible).

At first only a small part of the body, such as the legs, should be exposed for a short time to sunlight. Later, the area exposed and the length of exposure may be gradually increased. The head should always be protected. Over-exposure is shown by fatigue, restlessness, irritability, and feverishness.

The eye is extremely sensitive to exposure to the artificial ultra-violet rays, and it is essential to wear special protective goggles when in their vicinity.

Special lamps are also manufactured for the production of INFRA-RED RAYS, which are used when a more penetrating action of the skin is required, and as these rays produce an intense reddening of the skin more care is needed, and only small areas of the body can be exposed. These lamps are used for the treatment of inflammatory processes, such as arthritis, rheumatism, lumbago, and chilblains.

CHAPTER 5

PERSONAL HYGIENE

Structure, functions and care of the skin. Heat regulation of the body. Cleanliness in relation to health. Value of exercise and rest. Amount of sleep required. Clothing. Footgear.

PERSONAL hygiene is concerned with the maintenance of health and the prevention of disease, and includes the giving of proper attention to such matters as cleanliness, clothing, fresh air and diet, exercise, rest, etc.

THE SKIN

IN connection with personal hygiene the care of the skin is of considerable importance. The main functions of the skin are :—

(*a*) To serve as a protective covering to the body.

(*b*) To assist in the process of excretion.

(*c*) To regulate the body temperature.

(*d*) To act as a sensory organ, by means of its sensory nerve endings.

(*e*) To produce, under the action of ultra-violet light, vitamin D from a fatty substance, called ergosterol, which is present in the skin.

The skin is composed of two distinct layers, an outer one known as the epidermis or cuticle, and an inner one known as the dermis or true skin. The *epidermis*, which is the visible portion of the skin, varies in thickness in different parts of the body, being thickest on the palms and soles, and thinnest in the groins and on the face. The outermost portion or horny layer, consists of several rows of flattened cells, which are constantly being rubbed away and replaced by the growth of cells from the lower part of the epidermis.

All these cells have originated from the stratum germinativum, but, in their progress from below upwards, have become modified by the loss of water and the change of their protoplasm into fat, and the development of a tough cell envelope. During this metamorphosis the cells die and form a strong, elastic waterproof covering for the body.

The *dermis* consists of a dense network of connective tissue, containing blood vessels, lymphatics, and sensory nerve endings, by means of which the sensations of touch and pain and differences of temperature are recognized. The hair follicles and the sebaceous glands are also found in this layer. The ducts of the sebaceous glands, which contain an oily secretion, open into the hair follicles and pass up the sheaths of the hairs to the surface of the skin, the secretion serving to lubricate the hairs and keep the skin pliable.

Underlying the dermis is a loose, fibrous layer known as subcutaneous tissue or *hypoderm*, in which are found sweat glands, fat cells, and the deeper hair follicles. The sweat glands are very numerous, especially on the palms of the hands, and the ducts pass through the layers of the skin to reach the surface.

The sweat glands are constantly excreting perspiration, which consists mostly of water with a small quantity of salts and organic matter. Under normal conditions perspiration is not noticeable, since the water in it is constantly being evaporated from the skin and underclothing, but during hot weather or when taking vigorous exercise the amount of perspiration is greatly increased, for the purpose of assisting in the heat regulation of the body, the loss of the heat from the body depending upon the difference in temperature between the surface of the body and the surrounding air.

In the brain there is a heat regulating centre, the function

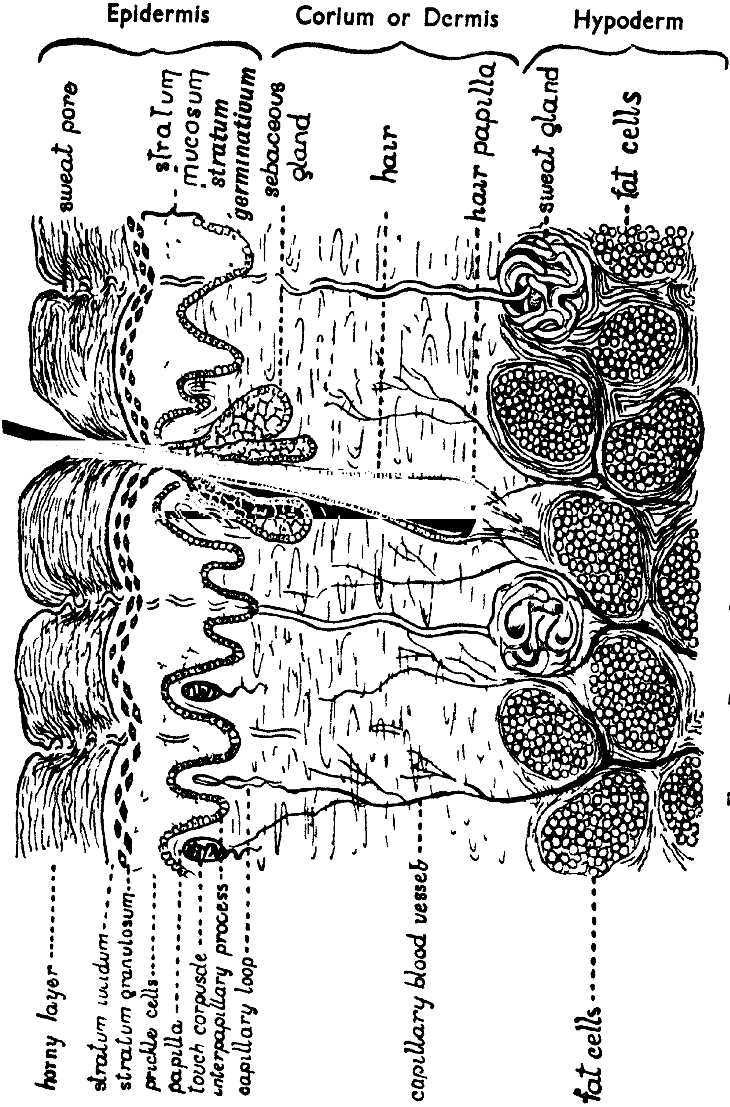


FIG. 21. *Diagram showing the Structure of the Skin.*

(From R W MacKenna's "Diseases of the Skin," by permission of Messrs Baillière, Tindall & Cox.)

of which is to maintain the body temperature at its normal level of 98·4° F. This centre controls the arterioles in the skin and causes them to dilate or contract as required, thereby increasing or diminishing the amount of blood circulating through it. If the body temperature tends to rise above the normal as the result of exercise, or hot weather, the arterioles in the skin are dilated and more blood consequently passes through it and perspiration is increased. The evaporation of the perspiration extracts heat from the skin and so lowers the body temperature. Heat is also being constantly lost from the body as the result of conduction, radiation, and convection, which processes are increased when, owing to the action of the heat regulating centre, more blood is being passed through the skin.

In cold weather the superficial arterioles are contracted and perspiration, radiation, etc., are diminished.

If the skin be not frequently washed, dried sweat and sebaceous secretion accumulate on it, as well as the dead superficial layers of the epidermis and any particles of dust or dirt, or any bacteria which may have been deposited on the skin.

As water alone is not capable of removing grease, soap is used with it for this purpose. Soap is made by boiling a fat or an oil with an alkali, in the case of hard soaps caustic soda being used, and caustic potash in the case of soft soaps. Soap always contains a certain amount of free alkali, and this combines with the greasy substances on the skin to form an emulsion, which carries away with it the particles of dirt blocking up the pores of the sweat glands.

The face and hands should be washed on rising and retiring and at mid-day. The hands also should be washed before each meal and before handling any food.

A hot bath, which has a soothing effect on the nervous system and is more cleansing than a cold bath, should be taken at least once or twice a week just before going to bed. A cold bath, which should be taken every morning on rising, has an excellent tonic effect on the body, particularly on the nervous system. Cold baths, however, do not suit all people, the test for suitability being that shortly after emerging from the bath, the bather experiences a sensation of warmth, and that whilst the body is being dried the skin glows and a feeling of general well-being is experienced.

In cases where the water supply is limited, or where there is not bath in the house, the body and limbs should be sponged with water, and after being dried, should be vigorously rubbed down with the hands.

The HAIR should be thoroughly brushed night and morning with a fairly hard brush, for the purpose of removing dirt and dandruff, which is composed of dead epithelium and dried sebaceous and sweat secretions. This brushing has also the effect of massaging the scalp and thereby improving its blood supply. The hair brushes should be regularly washed with soap and water to which a little ammonia has been added, as this helps in the removal of the grease.

It is not advisable to wash the scalp more often than about once every fortnight, as the use of soap removes the natural oil of the hair. There is no merit at all in singeing the hair, nor is there any justification for the popular idea that by so doing the " sap " of the hair is prevented from escaping.

Verminous conditions affecting the head and body are fully dealt with elsewhere (page 217).

For cleaning the NAILS, soap, warm water and a nail brush should be used. Nail brushes made of bristles sometimes puncture the skin under the nails, but efficient nail brushes made of rubber can now be obtained, and these are free from this drawback. Sharp instruments, such as a penknife, should not be used for this purpose, as they scratch the under surface of the nails and form uneven surfaces where dirt may accumulate. The finger nails should be kept fairly short and with a convex curve.

Though equally important, the cleaning and cutting of the toe-nails seldom receives the same attention as is the case of the finger-nails. The toe-nails should be cut straight across and not in a curved manner, as the latter method is a predisposing cause of ingrowing toe-nails, the actual cause being probably the pressure of ill-fitting footwear.

The structure and care of the teeth is dealt with fully in the chapter on Dental Hygiene.

EVACUATION OF THE BOWELS is a physiological reflex act during infancy, the necessary contractions and relaxations of the muscles concerned being brought about reflexly, as soon as the waste products reach the lower end of the bowel. After infancy a voluntary inhibitory control over this reflex is acquired, but too frequent inhibition tends to weaken the reflex. For this reason, therefore, it is particularly important that from early childhood the habit of evacuating the bowels at the same time each day should be established.

There is always a considerable quantity of the food eaten which is not digestible and other food that is not digested, and such undigested foods should be regularly evacuated. Otherwise, a in cases of constipation, the undigested food decomposes in the lower bowel as the result of bacterial action, the toxins formed are absorbed into the system and cause headaches, depression, loss of appetite, anæmia, offensive breath, furred tongue, and a general feeling of ill-health. Constipation is also probably the chief cause of hæmorrhoids, which is a varicose condition of the veins at the end of the bowel.

The more important predisposing causes of constipation are the following: lack of "roughage" in the diet, insufficient drinking of liquids, lack of exercise, and delay in attending to the reflex stimulus.

EXERCISE of the body is particularly important during the period of childhood, in order that the immature muscles and nerve cells may attain their proper development. Muscular exercise increases the rapidity and strength of the heart beats and the number and depth of the respirations' whereby more blood passes through the lungs and becomes aerated, so that an increased supply of oxygen becomes available to replace that which has been used up in the production of heat and energy. The increased movements of the diaphragm and abdominal muscles, resulting from exercise, aid digestion and help to prevent constipation, by massaging the abdominal alimentary organs, whilst an increased expression of bile from the liver results from its compression.

Insufficient exercise leads to a general lack of tone of the muscles of the body, and consequently to incorrect postures being adopted, and is a cause of stooping gait and round shoulders. It also predisposes to flat chest, through insufficient demands being made on the muscles involved in respiration.

Vigorous exercise should not be taken after meals, as the blood which is required in the abdomen in connection with the digestive processes would have to be diverted to the muscles, and digestion would thus be interfered with. Exercise should be carried out in moderation, and at least during school life should not be pushed to the length of becoming a test of endurance, such as occurs in long-distance cross-country runs, since the strain occasioned thereby may cause damage to the heart. Undue exertion on the part of persons unaccustomed to it may result in collapse, and those in sedentary occupations should be particularly careful in this respect. On the other hand, regular moderate physical exercise is beneficial, since it promotes a state of general physical fitness, which helps the body to carry out efficiently the ordinary requirements of life, and it also keeps the nerve centres in the brain and the associated nerves in regular training.

Suitable exercises and games for school children are very fully described in the Syllabus of Physical Training issued in 1933 by the Board of Education.

Rest and Sleep. Alternating periods of activity and rest are a physiological necessity for living organs. Absolute rest occurs when all physical and conscious mental activities are in abeyance, as during sleep. Complete physical rest is obtained when the recumbent position is adopted, as occurs when the children lie on their couches after dinner at the open-air schools.

Partial rest may be obtained by substituting one form of activity for another by

(*a*) ceasing mental activity and undertaking physical exercise ;

(*b*) altering the form of mental effort so that a different portion of the brain is exercised ;

(*c*) resting tired muscles and bringing unexercised muscles into use.

In addition to the nightly sleep, young children require a period of rest during the day, and this is best taken after the mid-day meal, when the blood, not being required for nourishing active voluntary muscles, can give unhampered attention to the processes of digestion.

In schools the change from one form of activity to another may be effected by :—

(1) sending the school children out to play after a period of mental work ;

(2) the giving of lessons according to a time-table so arranged that widely differing lessons are taken in sequence ;

(3) the selecting of suitable physical exercises from the Syllabus with the object of using different groups of muscles in turn.

A certain amount of rest in the form of sleep each night is necessary in order that the muscular and nervous systems may recuperate from the day's fatigue ; without such rest the organs and tissues would rapidly become exhausted and worn out.

The physiology of sleep is not yet fully understood, but it is considered that it is in all probability due to the suspension of the functions of the superficial cortical layer of the brain concerned with the conscious mind. It is thought that this is caused either by a temporary anæmia of the cortex, or by the toxins produced by fatigue acting upon the synapses of the brain cells and making the passage of nervous impulses too difficult for conscious mental activity to be maintained (see page 304).

During the process of going to sleep the sense of sight is the first to disappear, and at a later stage hearing, but the sense of touch does not usually appear to be completely lost, and often the slightest touch will awaken a sleeping person. So far as the mind is concerned the process of going to sleep causes the mental functions to disappear in the following order: will power, faculty of reasoning, imagination and memory, whilst on awakening these functions return in the inverse order.

Dreams probably only occur during light sleep, and are attributable to the fact that the faculties of memory and imagination are at the time partially active, though the power of reasoning is in abeyance so that uncensored fantastic mental pictures can be created. During sleep, in addition to the brain being rested, the activities of the other organs of the body, *e.g.* the heart, lungs, kidneys, etc., are diminished.

Authorities who have written on the subject of the amount of sleep required by children differ somewhat in their recommendations, but the following amounts may be taken as a fair average of their views.

Children 1– 4 years of age at least 14 hours.
„ 5– 7 „ „ „ 12 „
„ 7–10 „ „ about 11 „
„ of 10 and over at least 10 „

There is no doubt that many of the public elementary school children do not get sufficient sleep, particularly in the poorer quarters of the towns.

The signs of insufficient sleep in the case of children are those described on page 270, under the heading of Fatigue, but briefly they are as follows: the eyes look tired and may have dark rings under them; the children appear languid and drowsy, are dull at their lessons, and lazy or disinclined for muscular exertion.

The hygiene of the bedroom is important. The room should be well ventilated by keeping the windows open, not only during the day but also at night. Carpets are not recommended, as they harbour dust and are not easily cleaned, linoleum with small mats beside the bed are much more satisfactory. All furniture should be light and easily moveable. The bedclothes should be warm, but as light as possible; sheets, and not blankets, should be used to sleep between, as the former are much easier to wash. After the bed has been slept in, the bedclothes should be flung back so as to allow them to be thoroughly aired. No garments which have been worn during the day should be used to sleep in at night, a complete change should be made on retiring, the best material for nightwear being wool.

CLOTHING.—The hygienic purpose of clothing is to assist the heat regulating centre in maintaining the normal temperature of the body. The type and amount of clothing which should be worn requires to be varied according to the climate, weather, and season, and also depends on the age, sex, and occupation of the wearer.

Clothing should have the following properties:—

(*a*) It should be a bad conductor of heat, to minimize the outward passage of heat from the body in cold weather. The feeling of warmth or coldness of a material is dependent upon its heat-conducting properties, a material which is a poor conductor of heat feeling warmer than one which is a good conductor.

Of the various materials used for clothing, wool is the poorest conductor of heat, then comes silk, then cotton, and linen, which is the best conductor. As air is a particularly poor conductor of heat, the relative degree of the warmth of clothing materials largely depends upon the amount of air which they enclose in their meshes.

The wearing of an extra garment, say an under-vest, on a cold day is warmer than the substitution of a thicker undergarment for a thinner one, since not only is additional material added, but there is also the greater advantage of the extra valuable layer of non-conducting air between the two garments.

The warmth of clothing to some extent depends upon its colour, as dark clothes absorb heat better than light ones, and radiate it less readily.

(*b*) It ought to be of such a nature as not to interfere with the evaporation of perspiration, and it should therefore be porous, and, whilst capable of absorbing moisture readily, only permitting it to evaporate slowly. It is important that when wet with perspiration it should not cling to the skin, as in this case evaporation rapidly takes place and thereby much body heat is extracted and a chill is liable to ensue. Garments made of wool and other specially woven materials which entangle in their meshes a fair quantity of air, do not readily cling to the skin when wet with perspiration.

With regard to the usual materials of which clothing is made, wool under ordinary atmospheric conditions will absorb and retain a larger proportion of its weight of water than other materials.

Clothing should be permeable to air and not be tight fitting, since in that case the action of the muscles and the respiratory, circulatory, and digestive functions would be interfered with. Its weight should not be too heavy, should be evenly distributed, and suspended from the shoulders and not from the waist.

The materials for the making of garments come from both animal and vegetable sources, furs, wools, and silks being examples of the former, whilst artificial silk, cotton, linen, and indiarubber are examples of the latter. The furs of animals make, perhaps, the warmest of winter clothing, owing to the fact that a large amount of air is retained between the hairs.

Wool is the natural coat of the sheep. It consists of rounded, tubular fibres, made up of overlapping scales, like the slates on a roof, and containing a certain amount of oil. Clothing made from wool is the most valuable material, both as an outer garment and for underwear, since it is soft, warm, and elastic. It also has the property of absorbing moisture from the body without giving the feeling of dampness, owing to the moisture being absorbed and given out again more slowly than in the case of other materials, possibly because the moisture absorbed is retained under the scales of the wool fibres.

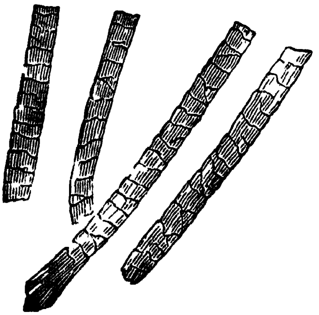


FIG. 22. *Wool Fibres* (× *about* 200).

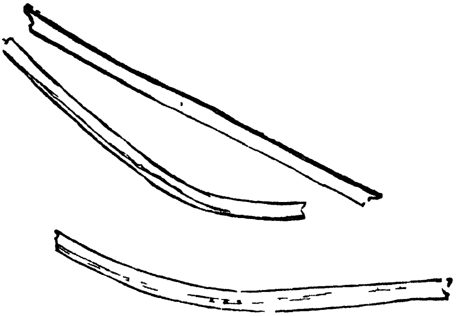


FIG. 23. *Silk Fibres* (× *about* 200).

(These illustrations, and also Figs. 24 and 25, are reproduced from Parkes and Kenwood's "Hygiene and Public Health," by permission of Messrs. H. K. Lewis & Co., Ltd.)

The disadvantage of wool is that it is irritating to some skins, is somewhat expensive, and requires great care in washing because of its tendency to shrink.

Silk is a material made from the fibres spun by the silkworm moth whilst in the caterpillar stage. The fibre, which is secreted by special glands in the caterpillar's head, is utilized to form a cocoon, which is a protective silken case for the caterpillar whilst undergoing transformation into the pupal stage preparatory to its emergence as a moth.

The advantages of silk clothing are, that it is a poor conluctor of heat, is strong in texture, has a pleasing appearance, is soft to the skin, and can be easily kept clean.

The disadvantages are, that it is expensive, and liable to shrink when washed.

Artificial silk is a very close imitation of the real article both as regards its manufacture and texture. The caterpillar produces the real silk in its own glands from the cellulose of the mulberry leaves on which it feeds, whilst the manufacturer of artificial silk has succeeded in transforming the cellulose from other vegetable sources, such as wood and cotton, into a substance very closely resembling real silk.

Cotton. The seeds of the cotton plant in their pods are surrounded by fluffy fibres, and it is from these fibres that cotton thread is made. When examined by the microscope, each fibre somewhat resembles a twisted ribbon. On the outside of the fibre are numerous fine hair-like appendages, which are helpful in the spinning, as they assist in binding the fibres together.

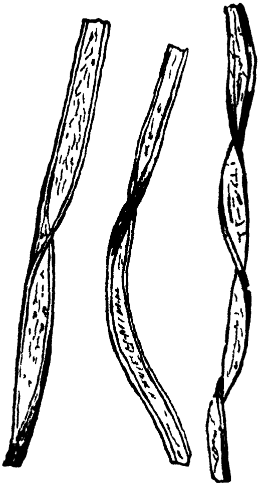


FIG. 24. *Cotton Fibres* (× *about* 200).

Cotton is graded according to the length of the fibres, and the number and nature of the hair-like appendages. Of the cottons imported into this country, the best is Egyptian cotton, next comes the American, and lastly the Indian. Cotton may be manufactured into "cellular" material, calico, flannelette, etc.

Cellular material is woven in such a manner as to enclose numerous air spaces, thereby enhancing the value of cotton for underwear, as the air in the air spaces renders the garments bad conductors of heat. *Calico*, so-called because it was first brought from Calicut in India, is merely an undyed cotton cloth, and can be purchased bleached or unbleached; when printed, it is used for making washable frocks. *Flannelette* is cotton woven by a special process into a loose cellular material resembling flannel in appearance; owing to its looser texture it is much warmer than calico. It is, unfortunately, unless specially treated, very inflammable, and great care has therefore to be taken in its use.

The advantages of cotton as clothing are that it is cheap and easily cleaned.

The disadvantages are that it is a good conductor of heat and soon gets wet and clammy when the body is perspiring freely, and is therefore not a suitable material for underwear.

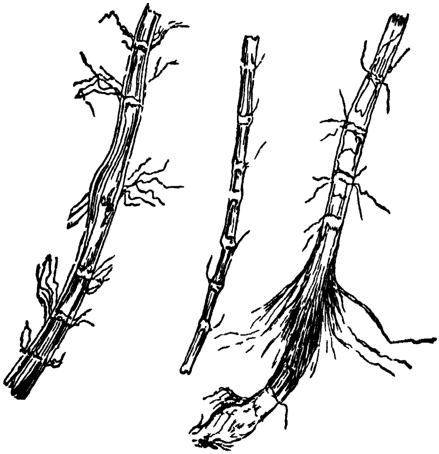


FIG. 25. *Linen Fibres* (× *about* 200).

Linen is obtained from fibres taken from the inner bark of the flax plant, which is grown largely in Ireland.

Linen, being the best conductor of heat of all the clothing materials mentioned, is not at all suitable for underclothing. With the exception of cheapness it has all the advantages and disadvantages of cotton, but to a greater degree.

A suitable *Outfit for a Schoolgirl* would comprise the following:—

A loosely fitting, knitted long woollen vest and knickers with separate washable linings, and, according to season, a flannel or cotton bodice, with serge or cotton frock supported from the shoulders. Pinafores may also with advantage be worn for use at cookery, laundry work, etc. Garters should not be worn. The night attire should be made of flannel, though cotton may be worn in the warmer weather.

For a Schoolboy the following are recommended :—

A loosely fitting long woollen vest and underpants, a cotton or flannel shirt, woollen jersey or pullover or jacket, and serge pants, or cloth suit.

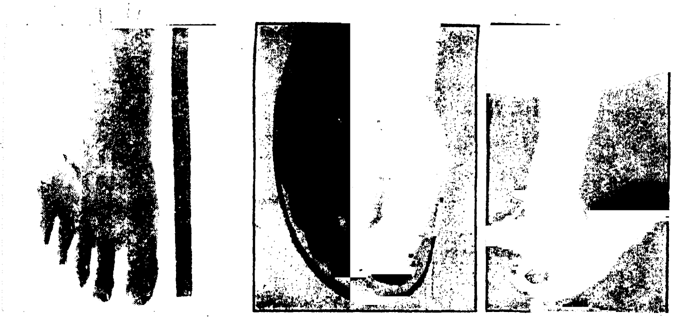
FOOTGEAR. The type, shape, quality, and condition of the footgear of school children is of considerable importance. Boots and shoes are worn for the purpose of protecting the feet from injury and of keeping them warm and dry. The soles, therefore, should be of sufficient thickness and the uppers watertight. In poor neighbourhoods, parents often unwisely delay, on the grounds of cost, the repairing of the footgear until it is quite beyond repair. The children would probably be better without boots at all than wearing ones in a bad state of repair, for in wet weather the soles become sodden, and much loss of body heat is brought about as the result of the feet evaporating the damp. This lowering of the body temperature, particularly in the case of debilitated or malnourished children, lowers their resistance to such diseases as colds, bronchitis, etc. Schools should be provided with apparatus for the purpose of drying wet footgear, and it is a good plan for children to keep a pair of slippers in school to put on if their boots or shoes are wet.

Wellington boots, made of rubber, whilst useful for outdoor wear on wet days, should not be worn continuously in school, as they interfere with the proper ventilation of the feet and legs, and the feet in consequence get hot and wet. Rubber-soled shoes should not be worn for general use, as they give no support for the arch of the foot, and they, therefore, predispose to the onset of flat-foot.

A hygienic boot or shoe should fit the foot comfortably, leaving a space of about half an inch beyond the end of the big toe, but there should be no looseness round the heel or instep. The inner edge should be straight and the toe of the boot so shaped as not to compress the toes from side to side. The heels should be broad to ensure stability, and not so high as to tilt the body forward. A considerable number of people cause deformity of their feet by wearing ill-fitting tight or pointed shoes or boots, the bones of the feet having to be distorted in order to get the boots on.

The natural undistorted foot is broader at the toes than at the heel, the toes being in perfect alignment with the metatarsal bones, and the inner border of the foot is slightly concave from toe to heel, whilst the outer border is slightly convex. In such a foot, if an imaginary line drawn down the middle of the great toe be extended backwards, this line would pass through the centre of the heel. In the case of any compression of the toes the direction of this line would be altered, the extent of the deviation being proportionate to the amount of distortion. The wearing of a narrow or pointed shoe cramps the foot and pushes the big toe and little toe towards the middle line of the foot, and the pressure of the pointed shoe over the joint at the base of the big toe causes the enlargement of the joint, such condition being known as a bunion, whilst pressure over the little toe causes a corn.

High-heeled shoes throw too much of the body weight forward on to the toes, thus aggravating the ill-effect of pointed shoes, and the centre of gravity of the body is also thrown forward and the balance upset. In order to neutralise the resulting tendency to fall forward, a compensatory increase in the lumbar curve (lordosis) is made to preserve the balance, the knees are kept bent, making the sacral region more prominent and causing an inelegant gait.

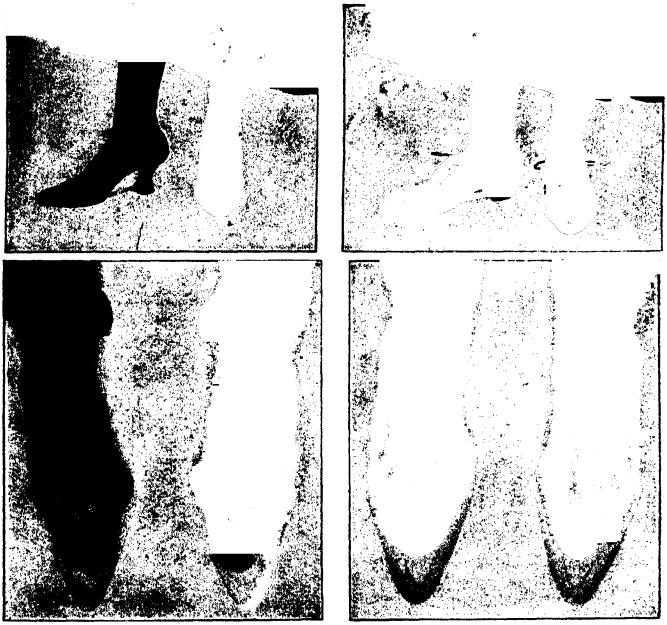


a

Normal foot, viewed from above. Note straight inner line, toes in alignment with foot bones.

b

Type of correct shoe having straight inner edge and space for toes. Note that X-ray view of foot in this shoe reveals no material distortion of normal relationship of toes.



c

French heels—used indiscriminately by many for shopping, dancing, climbing, walking—grossly distort the bones of feet, as shown by the accompanying X-ray of such feet, causing footache, backache, and "nerves."

d

The usual type of pointed-toed shoes distorting the bones of the feet, particularly those of the big toe.

FIG. 26. *Pictures showing how the Bones of the Feet can be distorted by Unsuitable Footgear.*

(*From "How to Live," by Fisher and Fisk, reproduced by kind permission of Messrs. Funk & Wagnalls Co., New York.*)

CHAPTER 6

FOOD

Purposes of food and classification of food substances. General principles of diet. Construction of dietary scale. Preservation of food. Diseases conveyed by food. Dangers of too much and too little food.

FOOD is required by the body for the following purposes :—

(1) To supply heat and energy for the maintenance of the body temperature, the functions of respiration and circulation, for all muscular effort, and for the body metabolism generally.

(2) To form new tissues during the period of growth, and to replace used-up tissues.

As an average child, which at birth weighs some 7 or 8 lbs., has this weight increased by some 15 to 20 times by the time it attains maturity, it will be appreciated that a very considerable amount of new body tissues has to be formed in the process.

Wear and tear of the body cells and tissues is constantly going on, both in childhood and in adult life, and food is necessary for the replacement of such worn-out tissues.

(3) To regulate the activities of the various organs.

As the action in the body of the different food substances is dependent upon their chemical properties, food materials are classified according to their chemical composition into proteins, which are the tissue builders ; fats and carbohydrates, which are heat and energy producers ; salts and water, which acts as a medium for conveying the other food constituents to those parts of the body requiring them. It is necessary that there must also be included in the food substances which are known as accessory food factors, or vitamins, which are regulators of metabolism. Further, it is desirable that a certain amount of fibrous, non-digestible food material, such as is present in vegetables, fruit, oatmeal, etc., should be included in the diet. This is known as roughage and is useful from the point of view of forming bulk, and assisting in preventing constipation by stimulating the large bowel.

Proteins, of which there are thousands of varieties, are complex chemical compounds occurring in both the animal and vegetable kingdoms. They contain about 17 per cent. of nitrogen and are essential constituents of all body cells. The body cannot assimilate proteins as such, and during digestion, therefore, the various proteins are broken down into some 20 simpler substances known as amino-acids, from which, after absorbing them, the body cells are able to build the particular protein or proteins of which they are in need. In consequence, amino-acids have been rather aptly described as " the building stones " of metabolism.

The precise amino-acids formed and their relative proportions differ according to the particular protein which has been digested, and as different amino-acids vary in their utility from the point of view of cell building, some proteins are naturally more valuable food materials than others. The proteins accordingly have been graded from this point of view, those producing the largest amounts of the amino-acids essential for cell building being spoken of as *" first class " proteins.* These are found only in foods obtained from animal sources, such as meat, fish, cheese, eggs, and milk.

Not all animal proteins, however, can be graded as first class, as for example gelatin, which is obtained from bones, tendons and other connective tissue.

The proteins obtained from vegetable sources, though deficient in certain of the essential amino-acids, are nevertheless a cheap and valuable source of protein supply, provided they are given along with sufficient first-class protein.

Just as animal proteins vary with regard to their " biological value," that is, their dietetic value, so vegetable proteins also vary. Thus, the proteins of potato, rice, cauliflower, and spinach are of greater value than those present in wheat and maize.

To sum up, so far as proteins are concerned, the diet should be varied and mixed as much as possible, and first-class proteins should on no account be omitted.

FATS consist of glycerine in combination with certain chemical substances known as fatty acids, the commonest of which are stearic, palmitic, and oleic acids. Fats may be of animal or vegetable origin, the former being found in such foods as meat, dripping, bacon, milk, butter, and cheese, yolks of eggs, the flesh of certain fishes, particularly herrings, and the livers of cod and other fishes. Vegetable fats are present in certain nuts, such as Brazil nuts and coconuts, and in various seeds, such as cotton seed and linseed.

As a source of supply of heat and energy to the body, fat is twice as valuable as proteins or carbohydrates, and in cold climates and winter weather comparatively large quantities are required in the diets. It is a good brain and nerve food, and is of special value to growing animals by increasing the power of the body to make use of lime salts, and so helps bone formation : it also increases the body resistance to certain infections.

On digestion, fats pass into the blood stream and are distributed to the individual cells of the body, where they are either stored up or oxidized to provide heat and energy.

In addition to the above functions, animal fats are important, in that they contain vitamins A and D. Lard, however, is deficient in these vitamins.

The term CARBOHYDRATES is used to include all kinds of sugars and starches. The chemical elements entering into their composition are the same as those in the fats, namely, carbon, hydrogen, and oxygen, but the hydrogen and oxygen in the case of the carbohydrates are always present in the same relative proportions as in water, namely, two of the former to one of the latter.

Starch is the insoluble form in which plants store up carbohydrates in their seeds, roots, etc. In the body the starches are, by the process of digestion, broken down into the sugar, glucose, which in turn is converted in the liver into a substance termed glycogen, which is stored there in reserve until sugar is required by the body, when it becomes reconverted into glucose.

The most important function of the carbohydrates is that of providing energy ; they are therefore especially valuable foods when a considerable amount of muscular work has to be undertaken. For this reason it is fortunate that carbohydrates are a particularly cheap form of energy-producing food.

The more important starch foods comprise wheat, oats, barley, rice, maize, which are known as cereals ; peas, beans, and lentils, known as pulses ; also certain roots and tubers, such as turnips, carrots, tapioca, potatoes, etc. Many of these sources of carbohydrates are rendered more valuable as foods, owing to the fact that they contain the vitamins B and C.

SALTS of certain of the elements are present in the body tissues, the most important being those of calcium, iron, phosphorus, sodium, potassium, magnesium, sulphur, chlorine, iodine, and copper.

In a well-varied diet the requisite mineral salts are usually present in sufficient quantities, but in the dietaries of the poorer classes there is a risk of a deficiency of some of these salts.

Calcium salts are necessary for most of the body functions, and are found in all the tissues of the body, entering largely into the composition of the bony skeleton and the teeth. They are requisite for the clotting of the blood, and for the normal action of the heart, and they are concerned also in the physiology of nerve and muscular activities. They are present chiefly in milk, cheese, eggs, most fruits, the pulses, and green vegetables; but wheat and milled cereals, meat and fish are deficient in them.

Iron salts enter into the composition of the chromatin of cells and the hæmoglobin of the red corpuscles, and a deficiency of these salts in the blood results in the condition known as anæmia. Iron is present in red meats, eggs and carrots green vegetables and liver. The last two have been found to be particularly valuable remedies for anæmic conditions, possibly because of the presence in them of traces of copper, which has been found to be helpful to the body in the efficient utilization of iron.

Phosphorus is largely required in bone formation and is present in the nuclei of all cells. It is present in the yolk of eggs, cheese, milk, wheat, oatmeal, peas, beans, green vegetables, and in many nuts.

Iodine is of great importance to the thyroid gland, and although only very small amounts are required, insufficiency of this element results in goitre, stunted growth or ill-health. Iodine is present in fish and water plants, *e.g.* water cress. *Chlorine* salts are present in all animal tissues, and in the form of hydrochloric acid is present in the gastric juice. Common salt, which is chloride of sodium, enters into the preparation of most foodstuffs.

WATER. Since about two-thirds of the body's weight is water, a liberal daily water consumption is necessary for health, as the chemical activity of the living cells depends upon the water within them, in which the various chemical compounds are held in solution. The equivalent of six glasses of water each day is advisable for an adult, and children require relatively more in proportion to adults.

VITAMINS are substances found in certain foods in extremely small amounts, their function being to regulate the nutritional processes. " Vitamins " was originally spelt " Vitamines " because it was erroneously considered that their chemical composition was that of " amines," substances closely related to ammonia. The first part of the word obviously has reference to their vital action.

A deficiency of one or more vitamins in a dietary which otherwise contains the correct proportion of proteins, fats, carbohydrates, and salts, leads to disease or impairment of health, and in children to interference with the normal rate of growth.

The vegetable kingdom is the primary source of all the vitamins, any of them present in animal tissues having been derived from the plant food eaten by the animal. It should be mentioned that in the process of cooking the vitamins may be destroyed, especially when soda has been added to the water in which the foods are boiled. It is customary to distinguish the different vitamins by associating them with alphabetical letters.

Vitamin A is essential for normal healthy growth, and for the maintenance of health and vigour throughout the whole of life. It is abundantly present in those food substances which are intended for feeding the young, such as milk, butter, and egg yolk. Liver contains a rich supply also, this organ acting as a reservoir for supplying the body needs. Insufficiency of vitamin A renders the body more susceptible to certain infections, particularly of the respiratory and alimentary tracts. Extreme deprivation of this vitamin results in an eye disease known as Xerophthalmia, in which, owing to inflammation and shrinking of the conjunctiva the secretion of tears is diminished, so drying of the eye results. This disease is seldom seen in this country, but is common in eastern countries, particularly Japan.

It has been estimated that in order to ensure a sufficient supply of vitamin A, about 1 pint of milk and 1 ounce of butter should be consumed per head per day, but the average consumption of milk and butter in this country is probably less than half this amount.

Vitamin B. Under this general heading are now included five different vitamins which have been discovered and termed respectively, vitamins B_1, B_2, B_3, B_4, B_5. Vitamins B_1 and B_2 are the only ones of practical importance, the others, so far as is at present known, being only concerned with the nutrition of rats and pigeons.

Vitamin B_1 is sometimes spoken of as the *anti-neuritic vitamin,* because its presence in the diet prevents the disease known as Beri Beri, which used to be common amongst Lascars in ships. This disease is characterized by a neuritis, resulting in severe muscular wasting, paralysis of the limbs, and affection of the heart and intestines. It was found that this disease was due to eating polished rice, that is, rice from which the outer husk and germ has been removed in the process of polishing ; and it is now known that the husk and germ are rich in vitamin B_1. This disease can be artificially produced in birds and animals by feeding them on polished rice ; conversely it can be rapidly cured by restoring the husk to the diet. Apart from this spectacular result of vitamin B starvation, a diminished supply has been found to interfere with growth and nutrition, food is poorly absorbed, and gastro-intestinal disturbances result. This vitamin, though present in most foodstuffs, is abundantly provided in yeast, green vegetables, the germ of wheat, and the seeds of plants. A moderate amount is present in eggs.

Vitamin B_2 is usually present in those foodstuffs which contain vitamin B_1. A diet deficient in this vitamin results in an inflammation of the skin, and accordingly it is sometimes referred to as the anti-dermatitis vitamin.

Vitamin C is sometimes spoken of as the *anti-scorbutic factor,* because its presence in a dietary is a preventive against the disease known as scurvy. This disease, which is characterized by a tendency to bleeding, particularly from the mucous membranes of the respiratory and alimentary passages, was frequently encountered in the old sailing ship days, and in the middle of the 18th century a Scottish Naval doctor discovered that lime juice was a cure for it. It was not, however, until 1919 that the vitamin C was definitely proved to be the active agent in the prevention of this disease.

Children who receive too little of this vitamin, though enough to avoid scurvy, may manifest symptoms of irritability, lose their former energy, and may experience pains which may be mistaken for "growing pains." The best sources for obtaining this vitamin are green vegetables, particularly cabbage and water-cress, and certain fruits, especially oranges, lemons, and grape-fruit. It is important to appreciate that prolonged cooking, especially when baking soda is used, destroys this vitamin.

Vitamin D is interesting in that it is an exception to the rest of the vitamins, because it can be manufactured by the human body. This is effected by the action of the ultra-violet rays of the sun acting upon a chemical substance present in the skin known as *ergosterol.* Vitamin D is sometimes spoken of as the *anti-rachitic vitamin,* since its presence is essential to growing children and animals for the proper utilization of calcium and phosphorus in the calcification of the growing bones and teeth.

Deficiency of this vitamin results in the disease known as rickets, in which the bones become softened and easily bent as the result of pressure, leading to such deformities as bow legs or knock-knees. Milk, butter, and eggs contain this vitamin, but the richest source is cod and halibut liver oils.

Vitamin E is one which has been found in animals to be essential for reproduction ; it is widely distributed amongst foodstuffs, and therefore does not require any special consideration in the planning of dietaries.

Vitamin F is not of any great importance to man ; in animals, however, its absence appears to affect growth and development of sexual maturity.

DIETARIES

ONE of the chief methods used for comparing the respective values of different foods is that of estimating the number of heat units they are capable of producing on combustion.

The heat unit used by physiologists is the *Calorie,* which is the amount of heat required to raise the temperature of 1 kilogramme of water by one degree Centigrade, and it is estimated that one gramme of protein will produce on burning or on digestion approximately 4·1 calories, one gramme of fat, 9·3 calories, and one gramme of carbohydrates, 4·1 calories. Food, in addition to providing material for the building of new tissues and the repairing of worn-out tissues, supplies the body with fuel to replace the energy consumed by the action of the voluntary and involuntary muscles.

The Nutrition Advisory Committee of the Ministry of Health issued in 1932 a memorandum on "The Criticism and Improvement of Diets," in which they recommended that the daily needs of the average "man" of the entire population of the country would be adequately met by supplying sufficient food to give 3,000 calories, such food to include 37 grammes, or thereabouts, of first-class protein.

In November 1933 the British Medical Association published a report on Nutrition, which a Committee specially appointed by them had prepared. In this report it was stated that 3,400 calories in food as purchased for a normal adult man should, after allowing for wastage in preparation, assure 3,000 available calories, which in the opinion of the Committee is "a reasonably safe figure to adopt, for it is sufficiently generous to permit working capacity to be maintained if the work is not really of a strenuous nature."

In arriving at this figure of 3,400 calories, made up from 100 grammes of protein (50 grammes of which should be first-class protein), 100 grammes of fat (of animal origin as far as possible), and 500 grammes of carbohydrate, the unavoidable waste in preparation and losses in digestion had been taken into account.

It will be noted that the Ministry of Health Committee recommended a daily dietary supplying 3,000 calories and 37 grammes of first-class protein, whilst the Board of the Medical Association Committee recommended 3,400 calories and 50 grammes of first-class protein. The apparent discrepancies between the recommendations of the two Committees aroused considerable discussion in the press, and eventually a joint conference between representatives of the two Committees was held, and their report was issued in May 1934. The report pointed out that the recommendations of the Committee of the Ministry were intended to be a rough guide for the calculation of dietaries of communities and institutions, and were not meant to be applied to individuals or even to single families.

On the other hand, the British Medical Association's Committee was required "to determine the minimum weekly expenditure on foodstuffs which must be incurred by families of varying size if health and working capacity are to be maintained." The Joint Committee pointed out that the alleged disagreement between the two reports was more imaginary than real, and they stated that the only workable solution for planning desirable dietary standards for individuals is the adoption of a sliding scale of calorie needs based on age, individual physique, occupation, and habits.

The following is the sliding scale adopted by the conference :—

SLIDING SCALE OF CALORIE REQUIREMENTS PER DAY

Individuals.	*Calories gross.*	*Individuals.*	*Calories gross.*
Man : Heavy work	3400—4000	Child 12–14	2800—3000
,, Moderate work	3000—3400	,, 10–12	2300—2800
,, Light work	2600—3000	,, 8–10	2000—2300
Woman : Active work	2800—3000	,, 6–8	1700—2000
,, Housewife	2600—2800	,, 3-6	1400—1700
Boy : 14–18	3000—3400	,, 2–3	1100—1400
Girl : 14–18	2800—3000	,, 1–2	900—1100

For the all-round average requirements of the entire population, or of large mixed groups of people, the conference agreed that the figure of about 3,000 calories per day can be safely employed, but that for individuals and single families, due regard should be paid to the sliding scale. With regard to the protein requirements, the conference found that the daily needs per man were between 80 and 100 grammes, and that the first-class protein should not be less than one-third of the total protein, and may with advantage be even one-half.

The factors influencing the daily number of calories required include the following :—

(1) The size of the individual, thus, as the average woman is smaller than the average man, it is usually taken for dietary scale purposes that a woman will require approximately 80 per cent. of the calories required by the average man doing similar work.

(2) The amount of muscular work undertaken, *e.g.* manual labourers, postmen, etc., require more calories than men engaged in sedentary work.

(3) Climatic conditions. People living in tropical climates do not require so many calories as those living in temperate climates, since the loss of body heat is less. Conversely, more calories are required by persons living in Arctic regions. Fewer calories are required in the summer than in the winter.

(4) Age. Persons of advanced age, because their activities are limited, require only about 75 per cent. of the calories of average adults. In the case of children, since they require food for the purposes of growth as well as for the production of heat and energy, they must be given more food than their relative size would indicate.

THE CONSTRUCTION OF A DIETARY SCALE

A DIETARY scale, whilst taking into consideration the usual dietetic habits and tastes of the individuals concerned, and including sufficient vitamins, salts, and roughage, should provide the number of calories required in accordance with the above table. Physiologists have laid down that the average daily calories derived from the proteins, fats, and carbohydrates should be in the proportion of 1, 2, and 5 respectively, and that at least one-third, but preferably more, of the proteins supplied should be first-class proteins.

Having ascertained the total amount of calories required from proteins, fats, and carbohydrates, the next step in the construction of a dietary scale is to determine the quantities of these substances necessary to provide the calories.

As has already been stated, one gramme of protein will produce on digestion approximately 4 calories, one gramme of fat will produce approximately 9 calories, and one gramme of carbohydrate approximately 4 calories. Food, however, is purchased in this country according to the English standard of weights, that is, in pounds and ounces, consequently it is necessary when working out dietaries to transpose grammes into ounces, an ounce being the equivalent in weight of 28·35 grammes. One ounce of protein will therefore produce 28·35 × 4 = 113·4 calories, one ounce of fat 28·35 × 9 = 255·15 calories, and one ounce of carbohydrate 28·35 × 4 = 113·4 calories.

Individual articles of food are usually composed of more than one of these food substances, and it is therefore necessary to know the percentage composition of the foods. Various books contain tables showing the analysis of the different articles of food giving the percentage proportions of proteins, fats, and carbohydrates.

It is thus possible to ascertain how many calories from the respective proteins, fats, and carbohydrates can be obtained from a given amount of the food in question. Thus, for instance, if it be required to find the food value of a tumblerful of milk (half a pint), the tables show that the percentage composition of average milk is, protein 4 per cent., fats 3·5 per cent., carbohydrates 4·5 per cent.

The number of ounces of protein in half a pint, or

10 ounces, of milk, will therefore be $\frac{4}{100} \times 10 = \cdot 4$ ounce. As one gramme of protein will supply 4 calories, one ounce (28·35 grammes) will supply $28{\cdot}35 \times 4 = 113{\cdot}4$ calories, and ·4 ounce will supply $113{\cdot}4 \times {\cdot}4 = 45{\cdot}36$ calories.

Similarly in the case of the fat, one gramme of which supplies 9 calories, the number of calories available from the fat in 10 ounces of milk is calculated as follows :—

$$\frac{3{\cdot}5}{100} \times 10 \times 28{\cdot}35 \times 9 = 89{\cdot}30 \text{ calories.}$$

The calculation for the carbohydrate will be

$$\frac{4{\cdot}5}{100} \times 10 \times 28{\cdot}35 \times 4 = 51{\cdot}03 \text{ calories.}$$

The total calories available in 10 ounces of milk will therefore be

$$45{\cdot}36 + 89{\cdot}30 + 51{\cdot}03 = 185{\cdot}69 \text{ calories.}$$

In constructing a dietary scale for a family or an institution, the procedure is to estimate first of all the total number of daily calories required according to the scale shown on page 91, and then apportion these calories in the ratio of one part protein, two parts fat, and five parts carbohydrate. Having ascertained this, the next step is to calculate the quantities by weight of proteins, fats, and carbohydrates which will give these calories.

Then a provisional dietary for each day would be drawn up, as for example, porridge, milk, and syrup with bread and butter for breakfast ; roast mutton, potatoes, cabbage, and marmalade pudding for dinner ; and bread and butter and jam for tea. A knowledge of approximately how much of each of these articles of food would be normally eaten at a meal is of course necessary, but in deciding on the dietary scale the actual amounts of the respective articles of food would be ascertained by consulting tables giving the percentage compositions of the different foods comprising the diet, and calculating the calories thus provided and making such adjustments of the amounts as will give the total calories required in the proportion of 1 of protein (one-third to one-half being of animal origin), 2 of fat, and 5 of carbohydrate.

Care must be taken to see that the dietary also contains sufficient vitamins, salts, and a fair proportion of roughage; and with the exception of such staple articles of food as bread, butter, and milk, no similar food should be served twice in the same day. Successive courses in each meal should be contrasted as much as possible.

PRESERVATION OF FOOD

THE choice of food is nowadays much greater than was formerly the case, owing to the fact that methods of keeping food fresh and wholesome have been brought to a high state of perfection. Thus imported meat, fish, butter, cheese, eggs, and fruit can be kept palatable and wholesome for a considerable period by means of refrigeration on steamers and cold storage on land.

The *sterilization* of foods and subsequent sealing in bottles or tins is now done on a large scale commercially, and is a valuable means of preserving foods for long periods, and consequently has led to a cheapening of food supplies. Tinned foods can occasionally be injurious to health, if either bacterial poisons have developed in the food prior to the sterilization, or if the sterilization process has not been satisfactorily carried out, for bacteria may then multiply in the food after the tins have been sealed. In this case there is usually a considerable amount of gas formed in the tins, the pressure of which has the effect of bulging the ends of the tins. Normally the top and bottom of any tins containing sterilized foods should be concave; but if they are convex, that is bulging, the contents should not be eaten. Owing to the care which manufacturers now take and to the close supervision of Public Health authorities, the risk from tinned foods may be considered almost negligible.

Chemical Preservatives such as boric acid, benzoic acid, salicylic acid, formaldehyde, etc., have been sometimes added to prevent decomposition, and artificial colouring agents have also been used, such as harmful aniline dyes, and salts of lead, copper and even arsenic, but the use of these preservatives has been considerably curtailed by Government regulations, and harmful dyes prohibited.

In the past a considerable amount of food adulteration was practised, chiefly by the admixture of cheaper substitutes, *e.g.* the addition of chicory to coffee, the mixture being sold as coffee, the addition of water to milk, or the addition of vegetable fats to butter.

Legislation has, however, strengthened the hands of Public Health Authorities in dealing with such adulteration, and they have powers to take samples of foods intended for sale, which they may submit for analysis, proceedings being taken against the vendor if the analysis shows that the food has been adulterated.

DISEASES CONVEYED BY FOOD

Food sometimes conveys disease. Thus, infected milk may be the cause of outbreaks of scarlet fever or typhoid, and milk obtained from tuberculous cows may cause tuberculosis in children, shell-fish from sewage-polluted waters may be the means of spreading typhoid fever, whilst outbreaks of typhoid fever, cholera, and dysentery have been caused by infection of the water supplies. Flies, by infecting food, are largely responsible for outbreaks of infantile diarrhœa and other diseases affecting the alimentary tract, which is not surprising when one is cognizant of their life-history and filthy habits.

Occasionally outbreaks occur of what is known as *food poisoning*, of which there are two types. One form is caused by the toxins produced by bacteria which were present in the food, but had been killed in the cooking. This is called *Ptomaine poisoning*, a characteristic of this type being that the onset occurs within a few hours of the consumption of the food.

The other form of food poisoning is due to living bacteria, whose normal habitat is in the intestinal tract. The illness is due either to the food having been insufficiently sterilized, or to its having been contaminated, after cooking, by human beings, flies, rats or mice. In this variety of food poisoning the illness does not usually commence until some 48 hours after the food has been eaten, and is characterized by gastro-intestinal disturbances, such as nausea, vomiting, diarrhœa, and abdominal pains, often followed by general bacterial infection of the system.

There are also certain parasites which may be introduced into the alimentary tract by eating raw or insufficiently cooked food. Included amongst these parasites are the *tape-worms*, the life-cycles of which are interesting. In some varieties the tape-worm stage exists only in the human intestines, and from time to time segments of the tape-worm, which contain the eggs, are evacuated.

If pigs or cattle eat food contaminated by such segments, the embryos are set free from the eggs and bore their way into the muscles, liver, etc., where they remain encysted in the larval stage. If food containing such cysts be eaten by man without having been cooked sufficiently to kill the larvæ, they develop into the adult tape-worm after reaching the intestines.

In another type of tape-worm, the tape-worm stage exists in the dog and the cystic stage in man, who becomes infected by eating lettuce, water-cress, etc., infected by the dog's excreta. It is consequently very important to wash thoroughly all fresh green food before eating it.

There is also a round worm known as *Trichina Spiralis*, rare in this country but common in Germany, which exists in an encysted form in the muscles of the animals infected. Pigs are particularly liable to this disease, and man is infected by eating infected and only partially cooked pork.

DANGERS OF TOO MUCH FOOD

If frequent overfeeding be indulged in, too much strain is put upon the digestive organs, leading to indigestion, flatulence, and constipation. When an excess of protein is regularly taken, high blood pressure and disease of the blood vessels results, especially in the case of middle-aged and elderly people who do not take much exercise. Moreover, an additional strain is thrown upon the kidneys, which are called upon to excrete excessive amounts of waste products, and this is apt to result in their disease. Elderly people are also likely to eat far more fat than is necessary, and this becomes stored both under the skin and in the various organs, including the heart, with the consequence that additional strain is placed upon the heart, particularly when unaccustomed muscular effort is undertaken.

Overeating in the case of children is not so likely to lead to active disease, since they usually take more exercise, and their digestive organs and excretory organs are more capable of making the increased efforts required. It is, nevertheless, a most undesirable habit to acquire, as, unless broken, it is likely to lead to the serious consequences mentioned above. The overfed child is usually languid, constipated and flabby, and has a pasty complexion.

DANGERS OF TOO LITTLE FOOD

A diet may be inadequate on account of its insufficiency in quantity or quality. Insufficiency of quantity is comparatively rare and is only likely to be met with in cases of marked poverty, but much more common are errors of quality, due to the diets being deficient in one or more of the various constituents of foods. This is a common occurrence in the diets of the poorer classes for two reasons, firstly, because they often have not the necessary knowledge of the proper kinds of food to take; and secondly, because owing to the higher cost of foods containing the first-class proteins, fats and some of the vitamins, their diets are frequently deficient in these constituents. If there be a deficiency of first-class protein growth of the children will be interfered with : if there be a deficiency of fats the children will be thin and angular, the bones easily felt through the skin, and the children become more susceptible to disease.

Other defects due to deficiency of vitamins or salts have already been referred to earlier in this chapter and elsewhere.

Speaking generally, too little food in the case of children results in a lack of physical and mental development. They become pale, flabby, and listless, lose weight, are unable to concentrate, are sleepy and easily tired, and eventually show the more obvious evidences of malnutrition, which are described in Chapter 17.

EFFECTS OF HEAT ON VITAMINS

The usual methods of cooking meats and vegetables do not materially affect vitamin A or its precursor carotene. Since this vitamin is susceptible to oxidation canning involves less loss from this source than cooking.

Vitamin B can resist considerable heating provided that the cooking medium is not alkaline, for which reason it is inadvisable to add soda when cooking vegetables or baking powder in bread-making. Yeast is much better as it incurs no loss in baking and itself contains the vitamin.

Legumes and leafy vegetables lose much of their vitamin C on boiling, but little is lost in the cooking of root vegetables. Cooking by frying has the most adverse effect, then baking, stewing and steaming, and boiling the least. Alkalis such as baking soda are very destructive. Canned vegetables and fruits can be better relied upon for providing this vitamin than the cooked substances.

Vitamin D is very resistant to heat and is scarcely affected by cooking and canning processes.

CHAPTER 7

BEVERAGES

Water. Tea. Coffee. Cocoa. Milk.

WATER

WATER, which is a compound of the two gases hydrogen and oxygen, is of vital importance to the existence of man. It enters very largely into the composition of his tissues, constituting about two-thirds of the body weight.

The amount of fluid circulating in the body appears to be a fairly fixed quantity, controlled by some form of regulating mechanism.

Its main uses in the physiological processes of the body are :—

(1) To facilitate the circulation of the blood.

(2) To assist in the formation of the requisite secretions, the digestion and absorption of food, and the excretion of waste products.

(3) To maintain the tissues in a soft and flexible condition.

An average adult gets rid of some 4 or 5 pints of water daily, chiefly in the form of urine, perspiration, and water vapour given off by the lungs in the process of expiration. The amount and relative proportions so excreted are dependent upon such factors as the atmospheric conditions, and amount of physical work undertaken.

A good deal of water is taken into the body in the form of solid food, about half of which, speaking generally, is composed of water. In addition to the water so obtained, the average adult also requires daily between three or more pints of liquid, which should be imbibed at evenly spaced intervals throughout the day.

Many people think that it is harmful to drink after exercise, but such a view would appear to be quite irrational. Another common belief is that the drinking of water at meals, by diluting the gastric juice, interferes with digestion, but there does not appear to be any physiological basis for such an idea: on the contrary, water assists in the digestion of foods by facilitating their reduction to a pulpy mass.

Water is not absorbed by the stomach, where it remains but a short time; on this account it can easily act as a means of introducing infection into the intestines, since the hydrochloric acid of the gastric juice is not given sufficient opportunity to destroy any bacteria which may be present in it. It is highly important, therefore, that all water supplies should be rendered free from all possible source of contamination.

WATER SUPPLY The primary source of all water supplies is rain. About a quarter of the rainfall is evaporated, and the remainder either flows away over the land in the form of streams or rivers, or percolates downwards through the superficial layers of the earth's crust until it reaches some impermeable stratum, on the surface of which it accumulates to form an underground reservoir.

The sources of public water supply are natural and artificial lakes, rivers, springs, and wells. As examples of *natural lakes* may be mentioned Loch Katrine, which supplies Glasgow, and Lake Thirlmere, which is one of the sources of the Manchester water supply. *Artificial lakes* are large impounding reservoirs made by building dams across narrow valleys, well-known examples being Lake Vyrnwy, the main water supply of Liverpool, and the Elan reservoir, which is the main Birmingham supply. In the case of public water supplies which are taken from natural or artificial lakes, the authorities obtain control of the whole of the catchment area, that is, the land over which the water has to flow on its passage to the lake. As far as possible, no habitations nor animals at all are permitted on this area, and the public are not allowed access to it. The waters of such lakes, which are known as upland surface waters, are usually very soft and good for domestic requirements.

The water from these lakes has often to be conveyed for long distances through large pipes, and before distribution to the consumers it is filtered, usually by passing it through large filter-beds, consisting of a layer of sand about four feet in thickness, under which are shallower layers of gravel and coarse stones, through which the water slowly percolates into pipes below, which carry away the purified water. The main filtering action in these beds takes place in the most superficial layer of the sand, where a jelly-like film of microscopical plants forms, through which any suspended particles present in the water are unable to pass.

River Water supplies may be quite pure if obtained from near the source of the river, but lower down on its course the water may become contaminated, by having drained into it water which has passed over manured fields, or the sewage from the neighbouring towns and villages. It will be naturally understood therefore, that when river water is used, most stringent precautions have to be taken to safeguard its purity, including sand filtration before distribution. A well-known example of river water being used as a public water supply is that of London, where over half the supply is obtained from the Thames.

For the proper understanding of the suitability of *spring and well water* for drinking purposes it should be appreciated that the superficial crust of the earth is composed of different layers which vary in different localities. Certain of these layers are permeable to water, *e.g.* sand, sandstone, or chalk, whilst others, *e.g.* clay, slate rocks or igneous rocks are impermeable to water.

Rain water falling on any area sinks through the permeable layers until it reaches an impervious layer. If this

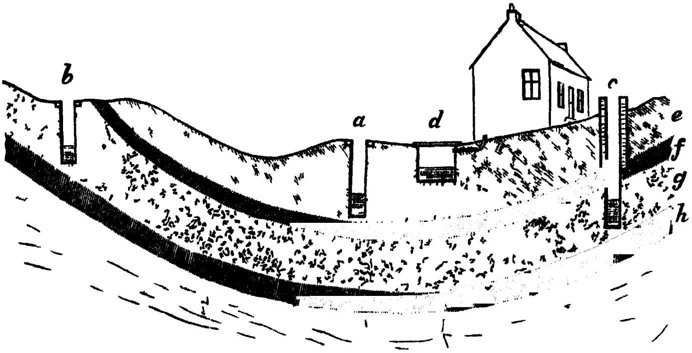


FIG. 27 *Diagram of a section of a valley, showing a water supply by wells.* (*a*) Surface well polluted by a neighbouring cesspool (*d*), (*b*) Surface well at a safe distance from the cesspool, (*c*) Deep well (safe) lined with masonry down to the first impervious stratum and protected above the ground level, (*e*) and (*g*) are permeable strata, (*f*) and (*h*) are impermeable strata

(*From an article on Water Supply in Black s " Medical Dictionary "*)

impervious layer crops out at the surface, the water lying on it pours out at this level as a spring. If, on the other hand, the impervious layer does not crop out on the surface, the water accumulates on this layer to form an underground reservoir

A well sunk to tap this water is referred to as a *shallow well,* and it is not advisable to drink the water from such a well, if it be liable to manurial contamination from dwellings or cultivated fields in the neighbourhood.

If, however, a boring be sunk through this first impermeable layer to a lower depth and water retained by a second deeper impermeable layer be tapped, such a well is referred to as a *deep well,* and though its water is apt to be hard it is usually satisfactory for drinking purposes, since before reaching the deeper layer it has generally travelled for a considerable distance underground, and become well filtered.

A variety of deep well, known as an *Artesian well,* is one in which there is an underground reservoir of water retained between two impermeable layers, the lower of which rises up, it may be many miles away, to above the level of the top of the well. This lower layer holds up the water in the permeable strata above it, and when the highest level of this underground reservoir is higher than the top of the well boring, water will flow out of the well.

In towns the water is often distributed by pumping it up to reservoirs placed in the highest part of the town, from which it is delivered by gravitation through the mains and service pipes to the consumers.

In order to keep local authorities informed as to the purity of their water supplies, samples are regularly subjected to both chemical and bacteriological analysis.

Amongst the matters investigated in connection with the chemical analysis of water is the question of its hardness, which is dependent upon the presence in solution of carbonates and sulphates of calcium and magnesium. The carbonates, which are held in solution by the presence of carbon dioxide in the water, are precipitated when the water is boiled and are responsible for the furring of kettles and boilers. Hardness of water due to these carbonates is referred to as *temporary* hardness, whilst that due to the sulphates is known as *permanent* hardness, as it cannot be thrown down by boiling the water. Lakes, river waters and shallow wells usually have very little hardness, and such waters are termed soft. Waters from deep wells, however, usually contain salts of lime and magnesium and are hard. Soft waters are more pleasant to wash with, are better for cooking purposes, and are more economical in soap than hard waters.

In some people the drinking of hard waters gives rise to dyspepsia and constipation. It has been suggested that in those districts where goitre is prevalent, the cause may be deficiency of iodine in the water, though this view is not now generally accepted. Peaty waters have a solvent action on lead pipes and have been occasionally responsible for lead poisoning. Sewage contamination of the water supply has been responsible for outbreaks of such intestinal diseases as typhoid fever, dysentery, and cholera.

Certain intestinal parasites, such as various types of worms, may also be introduced into the body through drinking water.

The water for school use should be from a public water supply, wherever possible, but in country schools it may be necessary either to have a deep well sunk, or to use spring or rain water. If the purity of the water cannot be relied upon, the water should be boiled or filtered. The only really satisfactory filter is the Pasteur-Chamberland filter, which consists of an unglazed porcelain tube enclosed in a metal case, the water to be filtered being forced through the tube. If such a filter be used the tube should be given a thorough cleansing by scrubbing with a brush every three days.

TEA

TEA is a drink made by infusing the dried leaves of the tea plant, which grows in India, Ceylon, and China. On analysis, the dried tea leaf is usually found to contain some 10 per cent. of *tannin* and over 2 per cent. of an alkaloid known as *theine*, which is very soluble, and, when the leaves are infused, is practically all dissolved out within three minutes. Theine gives tea its stimulating properties, for it is a drug which acts in small doses as a stimulant of the nervous system, but taken in excess, it produces nervousness, heart palpitation and digestive disturbances.

The tannin in the leaves, which is bitter and astringent, and is very liable to upset digestion, is much less soluble than theine ; consequently, in order to secure in the tea the benefits of the theine without the disadvantage of the tannin, the infusion of the leaves should not be allowed to proceed for more than four minutes.

A good plan is for the tea, after four minutes' infusion, to be poured out into another warmed teapot, in which the tea can be kept hot for as long as may be desired ; another good method is for the leaves, enclosed in a strainer, to be immersed in the teapot for four minutes and then withdrawn. China tea is less harmful than the Indian variety, since it contains less tannin.

If the water be hard it does not so easily dissolve out the necessary substances from the tea :· in such cases, therefore, the flavour may be improved by the addition of a pinch of sodium bicarbonate. Taking milk in tea is desirable, as it precipitates some of the tannin.

COFFEE

COFFEE is a drink made by percolating boiling water over roasted and ground coffee beans. The solution contains, in addition to some volatile and aromatic oils, which give the drink its flavour and aroma, about 1 per cent. of *caffeine* and some *tannin*.

The caffeine, which is similar to the theine in tea, but more potent, acts as a stimulant of the nervous system by removing the feeling of fatigue. Coffee, if taken at night, frequently prevents sleep, owing to the fact that the caffeine acts by enabling nervous impulses to break through the synapses more easily. (See pages 117 and 304.) Taken in excess it acts injuriously on the nervous, circulatory, and digestive systems. Neither tea nor coffee can be regarded as foods, their only value being their stimulating effect in cases of fatigue by removing the *feeling* of fatigue, though the nerve exhaustion still remains.

COCOA

COCOA is made from the seeds of a plant obtained mostly from the West Indies, and contains an alkaloid called *theobromine*, which is similar to theine and caffeine in its stimulating effects. Cocoa, however, differs from tea and coffee in containing a large amount of fat. Chocolate is a preparation made from cocoa, by the addition of sugar, starch, and flavouring agents.

Generally speaking, far too much tea is drunk in this country, especially amongst the poorer classes, who often allow the tea to " stew ", whereby all the tannin becomes dissolved. Neither tea nor coffee, unless well diluted with milk, should be taken with a meat meal. Tea or coffee should only be given in very limited amounts to children, and even then well diluted ; milk, or cocoa made with milk, are much more suitable.

MILK

MILK consists of an emulsion of fat in water, in addition to proteins, carbohydrate, salts and certain vitamins, and contains therefore all the essential food requirements. Although nature intended that the mother's milk should be the baby's sole food for some months after birth, it sometimes becomes necessary to use cow's milk as a substitute. The following table shows the approximate and comparative percentages of the main food constituents present in average specimens of human milk and cow's milk :—

	Human milk.	Cow's milk.
Protein . .	1 to 2	3 to 4
Fat . .	3 to 4	3½ to 4½
Carbohydrate (lactose) .	6 to 7	4 to 5

It will be observed that cow's milk contains considerably more protein than human milk, but less fat and sugar, and consequently, if it be used as a food for babies, it requires to be modified so as to make its composition as near as possible to that of human milk. Another important point of difference between cow's milk and human milk is in digestibility. In the stomach, milk is acted upon by the gastric juice and curdled, human milk forming a fine frothy curd easily acted upon by the hydrochloric acid and pepsin of the gastric juice, but in the case of cow's milk, a large solid clot is formed which is not so easily acted upon, and is consequently likely to cause indigestion.

There are two proteins in milk, termed caseinogen and lactalbumin respectively. The former, when acted upon by the rennin in the gastric juice, unites with calcium salts to form a curd, which is known as casein. There is three times as much caseinogen in cow's milk as in human milk, which explains why cow's milk on digestion forms a much denser clot. The lactalbumin is not coagulated by the rennin and remains in solution in the whey; it is, however, coagulated by heat and thus the skin on the surface of heated milk is formed.

The fat, which is present in milk in the form of minute globules, serves to build up and maintain the fatty tissues of the body, and is also a valuable source of heat and energy.

The carbohydrate exists in the form of lactose or milk sugar, and is the other source of heat and energy.

The mineral matters consist of (*a*) Calcium salts chiefly, which are of special importance in the building up of the bones and teeth. (*b*) Salts of potassium, which are utilized in the formation of the soft tissues. (*c*) Iron salts, which are necessary for the formation of the red blood cells. Deficiency of these salts in the diet may result in malnutrition, stunted growth, rickets, and anæmia.

The chief vitamins present are the A, B, C and D varieties, the amounts of these depending upon the nature of the mother's or cow's milk. Cows fed on grass usually have a sufficiency of vitamins in their milk, especially in the summer time; on the other hand, the milk of stall-fed cows, owing to the fact that they get little or no grass, is likely to be deficient in vitamins.

The great importance of milk in the daily dietary was shown by Dr. Corry Mann in 1926, as the result of his investigations into the feeding of a number of schoolboys living in separate "houses" in a residential institution. The number of boys per house varied between 30 and 35. He arranged that they should all receive, over a period of four years, a similar basic diet as regards protein, fats, and carbohydrates. In addition to this basic diet, however, the boys in the different houses were given certain supplementary articles of diet, *e.g.* those in one were given additional casein ; in other houses, sugar, vegetable margarine, fresh water-cress, or New Zealand butter from grass-fed cows ; and in one house the boys were given a pint of pasteurized milk daily.

At the end of the experiment it was found that the boys who had received the extra milk gained most in weight and height, the next best group being those who had received the extra butter.

Further evidence of the value of supplementary cow's milk has been furnished by the Scottish Board of Health, who, with the financial assistance of the Empire Marketing Board, carried out special investigations into the effect of milk upon the growth of school children. This work was undertaken in seven of the largest Scottish towns. Four groups of children were selected, one of which was given daily a supply of whole milk, a second group was given separated milk, a third group was given a biscuit of sufficient size as to be equivalent in calorie value to that of the separated milk given to the second group. A fourth group was also kept under observation, but not given any supplementary food, the children in this group being utilized as " controls ", that is standards with which the other groups of children could be compared, for the purpose of measuring the effects, if any, derived from the supplementary foods supplied.

It was found that those children who had received the milk increased both in height and weight to an extent some 20 per cent. greater than the children in any of the other groups. An important new point, however, which was discovered, was the fact that the separated milk was also found to be valuable from the point of view of promoting growth. The children who had been taking the milk acquired a sleek appearance, their hair became glossy, their nails smooth, and their spirits became high, as a result of which they became more difficult to manage, in short they exhibited the signs and symptoms of well-nourished children.

For some years the National Milk Publicity Council has been endeavouring to encourage the drinking of milk in school by the school children. Their scheme consists in arranging for a supply of one-third of a pint of milk in sealed bottles, the milk being drunk by means of a sterilised straw after perforation of a patent stopper. The bottles are collected and cleansed by the dairyman.

Under this scheme a charge of 1d. per bottle was made. From October 1934 arrangements, suggested by the Milk Marketing Board and approved by the Minister of Agriculture, were made to reduce the price from 1d. to ½d. for milk drunk in the schools, the Milk Marketing Board providing a subsidy to enable this to be done. The important proviso, however, was made that the subsidy would be available only in those cases where the source and quality of the milk had been approved by the Medical Officer of Health. In connection with the scheme the Board of Education urged that in those areas where a sufficiency of pasteurized milk was available such milk should always be provided.

As milk forms an excellent medium for the growth of bacteria, the greatest care must be taken to prevent them from gaining access to it, and arrangements also should be made to keep the milk under conditions unfavourable to the multiplication of any bacteria which, despite all precautions, may have gained access.

Not only should the cows be thoroughly healthy and kept clean, but the strictest detailed attention should be given to ensure absolute cleanliness during the process of milking. Only sterilized utensils should be used and the milk should be cooled immediately after being drawn.

Every precaution must also be taken to ensure that the

FIG. 28. *Children taking their morning milk at school.*

(By permission of The Sunbeam Photo Ltd., Margate.)

milk is kept free from all possible contamination during the process of transport and delivery or storage in the shop.

In the house, milk, if not delivered in a bottle, should be at once poured into a clean jug which has just been scalded with boiling water, and then rinsed with cold water. The jug should be kept covered by a plate or saucer or a slip of glass, and it should be kept in as cool a place as possible. In hot weather any bacteria which may have gained access to the milk will multiply rapidly. This can be prevented by scalding, that is, heating the raw milk just to the boiling point and then cooling it rapidly. Whether or not this be done the jug or milk bottle should be placed in a basin of cold water which is renewed frequently.

Though raw milk has been shown to be of such undoubted food value to children, it unfortunately may also act as a medium for conveying disease either from the cow itself or from infected human beings. The most important of such diseases is tuberculosis, and it has been found that over 6 per cent. of the samples of raw milk are infected with tubercle bacilli. Outbreaks of various infectious diseases, which have occurred from time to time, have been traced to infection of the milk supply with the organisms responsible for scarlet fever, diphtheria, typhoid fever, dysentery, summer diarrhœa or food poisoning.

For these reasons some people consider that the benefits derived from drinking milk are more than outweighed by the risks of possible infection incurred. For those holding such views the remedy is not to decline to drink milk, but to drink milk rendered safe by some form of heat treatment, either by pasteurization or by scalding.

In an endeavour to raise the standard of purity of milk supplies, the *Milk (Special Designations) Order of* 1923 was issued by the Ministry of Health, which laid down certain standards with which milk sold under this Order must comply. As the names of the various grades of milk which could be sold under this Order had proved somewhat confusing to the public, the Minister of Health issued the *Milk (Special Designations) Order*, 1936. Under this Order are three main grades of designated milk, but milk vendors may still sell milk not complying with the Order, provided it is not claimed as one of the " designated " milks.

The three grades of designated milk are as follows :—

(1) *Tuberculin Tested Milk.* Cows from which such milk is derived must be examined at least every six months by a veterinary surgeon and submitted to a tuberculin test at intervals of between two and six months. The herd must be isolated from all other cattle. Bottles containing the milk must be tightly closed with a cap bearing the address of the bottling establishment and the words " Tuberculin Tested Milk." If the milk be bottled at the place of production it may be labelled *Tuberculin Tested Milk (Certified).* The milk must not show evidence of any coliform bacilli in $\frac{1}{100}$ millilitre and must pass the Methylene-Blue Reduction Test.

The Order permits the dairyman to Pasteurize the milk and label it as *Tuberculin Tested Milk (Pasteurized)*, but such milk, on analysis, must not show evidence of more than 30,000 bacteria per millilitre.

(2) *Accredited Milk* must have been produced by cows which are regularly examined by a veterinary surgeon every three months. The cows producing the milk must be kept separate from all other cows in milk. The same bacterial tests for purity are required as for Tuberculin Tested Milk. If the milk be bottled at the farm it may be labelled *Accredited Milk (Farm Bottled)* : if not bottled at the farm it must be consigned in unventilated sealed containers labelled " Accredited Milk," with full particulars of the dairy, date, and whether morning or evening milk. Bottles must be tightly closed.

(3) *Pasteurized Milk* must be heated to a temperature of between 145° and 150° F. for at least half an hour and immediately cooled to a temperature of not more than 55° F.

The milk must not be otherwise treated by heat. The bacterial content shall not be greater than 100,000 bacteria per millilitre, and such milk must be labelled " Pasteurized Milk " on the vessels in which it is transported or exposed for sale.

With regard to pasteurized milk there has been a good deal of controversy as to whether or not the process destroys some of its nutritive properties. Drs. Stirling and Blackwood of the Hannah Dairy Research Institute in 1933 published a report on this subject, in which they stated that whilst pasteurization killed all the disease-producing organisms in the milk, it also destroyed about 50 per cent. of the vitamin C, but this latter effect was not important, as in any case milk is a poor source of vitamin C and should not be relied upon to supply this vitamin. So far as vitamin D is concerned there was no conclusive evidence as to whether or not this vitamin was affected.

The report goes on to say that " There are, therefore, strong grounds for the belief that infants can satisfy all their requirements on diets of adequate amounts of pasteurized milk provided that extra vitamin D and, of course, vitamin C are added to the diet." Such vitamins can be provided by the simple addition to the diet of cod liver oil and orange or lemon juice.

CHAPTER 8

ALCOHOL

Its effects on body and brain.

ALCOHOL is a liquid generated by the fermentation of sugar and other saccharine matter, and forms the intoxicating element of fermented liquors. This is known technically as ethylic alcohol, to distinguish it from many other varieties of alcohol known to chemists. Commercially it is produced by the fermentation of the carbohydrates of various fruits and grains, wines being made by fermenting the sugar from the grape, whisky by distilling malted barley, and beer by fermenting the starch from barley, with the addition of hops. Certain other substances are also produced during the process of fermentation which give rise to the particular flavour of the wines and spirits.

The proportion of ethylic alcohol in beers, stout, and cider varies between 3 and 7 per cent. ; in clarets, burgundy, and champagne, 9–13 per cent. ; port and sherry, 15–22 per cent. ; the spirits, whisky, brandy, and gin, 37–43 per cent.

When referring to the amount of alcohol present in spirits it is customary to speak of it as being either " under proof " or " over proof." The origin of these terms is interesting. Formerly it was the practice to test the strengths of various wines or spirits by pouring some of it over gunpowder and applying a light to it. If the spirit had a large percentage of water in it, the gunpowder would not be ignited, and so the spirit was regarded as " under proof." The term " proof " spirit now, however, refers to a definite percentage of alcohol determined by Act of Parliament, namely 57 per cent. by volume.

Much literature has been written both for and against the use of alcohol and, as is usual in controversial subjects, each side tends to exaggerate the points in favour of its view. Taken occasionally in moderation by adults it probably does little or no harm, but when taken to excess there can be no doubt that it produces definitely harmful effects. Some people are more susceptible than others, and in some cases even comparatively small daily amounts may do harm.

Alcohol is eliminated from the body by a slow process of oxidation which may take as long as 24 hours. As in the process a small amount of heat is generated, alcohol can be regarded as having some slight food value, but its importance in this respect is almost negligible and is sometimes greatly exaggerated.

Small quantities of alcohol do not appear to have any material affect upon the processes of digestion, but taken in excess definite digestive disturbances are brought about as the result of inflammatory action on the stomach, intestines, and liver. The action of cocktails as stimulants to jaded appetites is dependent upon their irritative action upon the gastric mucous membrane, which creates a false impression of hunger.

Alcohol is sometimes taken to relieve a feeling of cold, or prior to going out of doors on a cold night in order to " keep out the cold." Physiologically, such a practice is quite wrong, since alcohol has an action on the heat-regulating centre, causing it to dilate the superficial cutaneous blood vessels and so divert more blood to the skin, thereby producing a feeling of warmth by raising the skin temperature. In so doing, however, a greater radiation of heat from the skin occurs, with the result that the body temperature as a whole becomes reduced, possibly with serious effect, since the body resistance to bacterial infection, such as pneumonia, may be thereby reduced. On account of its action on the heat-regulating centre many Arctic explorers have not allowed the use of alcohol on their expeditions.

Much discussion has arisen as to whether alcohol is a mental stimulant or a narcotic. It is common knowledge that members of dinner parties, after they have had a little wine, become more sociable and animated and converse more freely. It is largely for this reason that it has been regarded as a stimulant, but this effect on the human temperament can be explained from the physiological point of view as being really brought about, not as the result of a stimulation of nerve cells or fibres, but as the result of an inhibitory action taking place at the junctions between the endings of adjacent nerve cells, known technically as *synapses* (see page 304). It is considered that these synaptic junctions are weak points in the paths of the nerve impulses, which comparatively readily give way under strain, or the influence of fatigue or drugs.

In the course of the evolution of the human brain there have been gradually developed in it collections of nerve cells (nerve centres) with specific functions. The oldest of these centres were those responsible for controlling the circulatory and respiratory systems, later those centres which were of importance for controlling those functions which were of value for the survival of the individual or the race were developed. More recent still in development have been centres for speech, for controlling the emotions, for self-criticism, etc. The older these centres in the history of the race, the firmer are the synaptic junctions associated with them, and the easier it is for the nerve impulses to cross over them. Conversely, the synaptic junctions associated with the more recently acquired or higher nerve centres are less stable, and offer proportionately more resistance to the passage of nerve impulses the later they have appeared in the history of development.

The effect of alcohol on the brain is really that of anæsthesia, whereby some of its functions are inhibited, the first centres to be inhibited being those most recently acquired, other centres becoming inhibited in the reverse order of their evolution.

One of the effects of taking alcohol is to make the naturally retiring person more talkative, because the centre which usually keeps him reticent is temporarily damped down and he, therefore, becomes less self-conscious, not so self-critical, and less appreciative of the possible effects of any of his remarks, hence the success of the " after dinner " speaker. But in this connection it must be appreciated that usually most of his audience have their critical faculties similarly dulled and are consequently easily amused by his humour and wit.

A later effect of alcohol is interference with the speech centre, resulting in slips in the pronunciation of words and phrases, difficulty in carrying out co-ordinated movements, as shown by clumsy actions such as the knocking over of glasses, the affection of the vision centre as shown by double vision, lack of control of the emotions as evidenced by the person becoming hilarious, sentimental, querulous, or pugnacious.

Still later, balance is disturbed, and the gait becomes unsteady, then the inebriate is unable to stand, the final stages being interference with the respiratory centre, and last of all the heart centre.

Any person driving a motor-car should not take even small amounts of alcohol beforehand, for it inhibits natural caution, making the driver less apprehensive of danger. It slows the reaction time, so that in the case of an emergency, when speed of decision and rapidity of action are necessary, the driver does not decide and act sufficiently quickly when a delay in action of a fraction of a second might result in an accident.

Continued indulgence in alcohol produces digestive disturbances and injurious changes, particularly in the liver, kidneys, and arteries. Will power, attention and reasoning become weakened, judgment less accurate, and skilled movements requiring precision are adversely affected, with the result that work becomes more careless, and in factories mishaps with machinery are more likely to occur.

A person who habitually drinks alcoholic beverages undoubtedly lowers his resisting power to bacterial infection, and so has less chance of recovery from blood poisoning, pneumonia, phthisis, etc. Total abstainers are granted policies by many insurance offices on more favourable terms than non-abstainers, both for life and accident insurance.

With regard to the social effects of alcoholic indulgence, there can be no question but that intemperance is largely a contributory factor to many cases of poverty, and in those families where there is only just enough income to provide for the bare necessaries of life, money spent in drink must of necessity mean deprivation somewhere, and only too often in the quality of food.

Many acts of cruelty, assaults, and other anti-social acts leading to police court proceedings, are not infrequently due to drink.

The mortality tables of the Registrar General show that people in occupations which render them more liable to excessive drinking, such as inn-keepers, etc., have a relatively high mortality rate from diseases attributable to alcoholism.

Of recent years there has been a considerable decrease in the amount of alcohol consumed by the population, and the practice of heavy drinking has also much diminished. Many factors have led to this improvement, particularly the increase in the price of alcoholic beverages, the curtailment of the hours during which drink can be purchased, and the improvement in social conditions, such as the steady demolition of slum property and the provision of better housing accommodation, the development of the cinema and broadcasting, the increase of facilities for outdoor recreation, etc. This improvement in sobriety has had a markedly beneficial effect upon the general health of the community.

CHAPTER 9

INFECTION AND IMMUNITY

Classification of Bacteria. Theories of Immunity. Types of Immunity. Schick and Dick Tests. Modes and Spread of Infection. Disinfection.

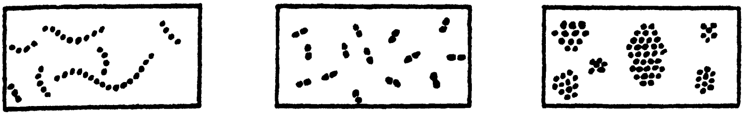
BACTERIA

BACTERIA, which are microscopical plants, are the smallest known forms of living matter, even the largest being less than a thousandth of an inch in length. Under favourable conditions they multiply at a prodigious rate, it being possible for one bacterium at the end of 24 hours to produce trillions of descendants.

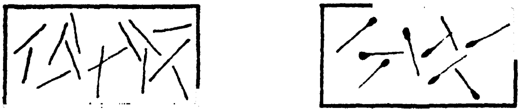
Their method of reproduction most commonly takes the form of dividing into two. Some of them, however, under certain conditions, have the power of producing " spores," which are much more resistant to adverse environmental conditions, such as drying, heating or contact with antiseptics, etc. But when the environmental conditions become more favourable these spores can develop into bacteria.

Bacteria are classified into groups according to their shape, those which are rod-shaped being termed *bacilli,* as, for example, the bacilli causing typhoid fever, diphtheria, and tuberculosis.

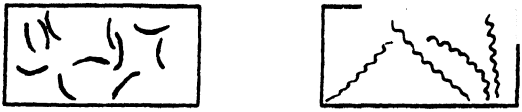
Those which are spherical in shape are known as *cocci.* If cocci are grouped in pairs they are known as diplococci, as, for example, the pneumococcus, which causes pneumonia. When they occur in a chain-like formation they are known as streptococci, examples of this type being the bacteria usually responsible for blood poisoning, and probably also those causing rheumatism and scarlet fever. When the cocci are arranged in clusters they are known as staphylococci. Certain common skin infections, such as boils, styes, and impetigo, are caused by staphylococci.



STREPTOCOCCI DIPLOCOCCI STAPHYLOCOCCI



BACILLI BACILLI WITH SPORES



VIBRIOS SPIRILLA

FIG. 29. *Some common types of Bacteria.*

Other bacteria are curved in shape. If there is only one curve, as in the case of the organism responsible for cholera, they are classified as *vibrios*, whilst if there are several curves, like a corkscrew, the organisms are called *spirilla*, examples of spirilla being the organisms responsible for syphilis and for sleeping sickness, which is a disease of tropical Africa.

Considering that bacteriology is a comparatively recent science, it is remarkable how much progress has already been made in discovering the micro-organisms responsible for many of the communicable diseases. In the case of certain infectious diseases, however, which, by analogy, are assumed to be caused by bacteria, the micro-organisms responsible have not yet been discovered, probably because they are too small to be seen under the microscope. Such ultra-microscopical organisms are referred to as *viruses.* Smallpox, measles, and typhus fever, in the case of man, and foot-and-mouth disease in animals, are considered to be virus diseases.

Though bacteria may survive cooling to low degrees of temperature, all bacteria are killed by boiling, and direct sunlight, particularly the ultra-violet rays, has a powerful destructive effect on most bacteria.

All bacteria, however, are not enemies of mankind. Some are of value, such as those which cause the ripening of cheese, or the fermentation associated with the making of alcoholic beverages, or the breaking up of dead organic matter, thus enriching the soil. Bacterial action is also depended upon in certain methods of sewage disposal. It is also probable that many varieties of bacteria normally present in the intestines are of some assistance in the digestive processes.

Bacteria are responsible for what is known as the infectious diseases, and for some of the contagious diseases. The term *contagious disease* is applied to those in which the disease is usually spread by direct contact with an infected person, whilst the term *infectious diseases* includes those diseases which can also be contracted by indirect means through the medium of the air, or by the handling of infected articles.

IMMUNITY

IMMUNITY is the capacity possessed by some human beings and animals which renders them, wholly or partially, non-susceptible to the attacks of certain bacteria and their poisons.

When bacteria gain access to the tissues they commence to multiply and to secrete poisonous substances which are known as *toxins*. Certain of these toxins pass out of the bacteria into the blood stream (exotoxins), other toxins (endotoxins) normally remain within the bodies of the bacteria, and only gain access to the blood stream when the bacteria are killed and disintegrated.

It is the exotoxins which are responsible for the different specific symptoms of the various infectious diseases, whilst the endotoxins are responsible for those symptoms common to all infections, such as high temperature, malaise, etc.

Bacterial toxins are highly poisonous, even in very minute doses, and were it not for the defences against the bacteria and their poisons which the blood has the power of manufacturing, the human race would long ago have become extinct.

The first of the body defences to be brought to light was that now known as *phagocytosis*, which was discovered in 1884 by the Russian biologist, Metchnikoff. He found that the white corpuscles of the blood had the power of approaching, engulfing, killing, and, by means of special ferments, digesting the invading bacteria, whilst certain of the fixed cells in the connective tissues had also the power of killing and eating bacteria. These white corpuscles and fixed cells are called phagocytes. The matter (pus) from an abscess, when examined under a microscope, is seen to consist of enormous numbers of dead and dying white corpuscles containing within them the dead bodies of the bacteria with which they have been engaged in mortal combat.

Another interesting discovery in regard to phagocytosis was later made by Sir Almroth Wright, who found that, before the leucocytes, or white corpuscles, could engage in combat with the bacteria, the latter had to receive special preparation by substances which occur in the blood, which he called *opsonins*, in the absence of which phagocytosis cannot take place.

There are three other special defensive substances which the blood plasma has the power of manufacturing, when bacteria invade the body, viz. bacteriolysins, precipitins and agglutinins. The *bacteriolysins* have the power of dissolving bacteria, but in so doing they set free in the blood stream their endotoxins, the effects of which have been previously mentioned. The *precipitins* have the power of precipitating or throwing out of solution the toxins which are dissolved in the blood, and thereby rendering them innocuous. The *agglutinins* possess the power of causing the bacteria to adhere together in clusters and of paralysing their activity.

The defences just described are for the purpose of dealing with invading bacteria, but the blood plasma, when bacterial toxins have got into the blood stream, has also the power of manufacturing certain substances, known as *antitoxins*, which are capable of neutralizing the toxins present.

Unfortunately, it takes some little time before the blood can produce sufficient antitoxins to combat the toxins which have been and are being formed, and the toxins having the advantage of a start, may do serious damage, or even cause the death of the patient before sufficient antitoxins can be produced. To tide over this emergency scientists have devised a method whereby antitoxins can be obtained from outside sources and injected into the patients' tissues.

This is the method employed in the modern treatment of diphtheria. In the case of this disease antitoxin is prepared from the blood serum of horses which have been inoculated with increasing doses of diphtheria toxin, with the result that there is gradually produced in the blood of these horses a large quantity of diphtheria antitoxin.

Prior to the introduction of this method of treatment about 30 per cent. of all persons who contracted diphtheria died, but so successful has this antitoxin treatment been that Fever Hospitals are now usually able to keep the death-rate of their diphtheria cases below 3 per cent.

Immunity is quite a relative term, since it may vary from more or less complete protection to that of only a slight degree, whilst it may also vary in the length of its duration.

Immunity is usually classified into two main types, termed respectively, natural and acquired immunity.

NATURAL IMMUNITY is an inherited immunity to one or more of the infectious diseases, possessed to a greater or less degree by all the individuals of a particular species. For instance, the lower animals have a natural immunity to most of the human communicable diseases, and man in turn has a natural immunity to some of the infectious diseases to which the lower animals are subject, such as swine fever or dog distemper.

ACQUIRED IMMUNITY is an immunity which is not natural or common to the species, but has been acquired by the individual, either as the result of an attack of the disease, or produced artificially by the introduction of a toxin, antitoxin, vaccine or virus.

There are several methods by which immunity may be acquired, and these are grouped under the headings of (*a*) active immunity and (*b*) passive immunity.

(*a*) ***Active Immunity*** is one which has been acquired as the result of the formation of antitoxins in the blood, produced as a defensive measure, either during a previous attack of a particular infectious disease, or from exposure of the body to repeated small doses of the infection, as in the cases of doctors or nurses in fever hospitals, who though constantly exposed to infections usually escape the diseases.

Active immunity can also be produced by the introduction into the body, either of a *vaccine*, that is, the dead bodies of the bacteria of the disease suspended in a solution, or of a virus which has had the activity and virulence of its micro-organisms modified. Examples of the former are vaccines for the prevention of typhoid fever, influenza, colds, boils, etc., whilst the most familiar example of the use of a modified virus is in the case of vaccination against smallpox. The lymph used in vaccination contains living organisms which have been rendered comparatively innocuous. These are obtained from calves which have been infected by cowpox or vaccinia, a disease of the cow due to the same organism which causes smallpox in human beings but which is modified in the cow.

(*b*) *Passive Immunity* is one that has been brought about by the introduction into the system of blood serum obtained either from animals whose blood has developed a large amount of antitoxin as the result of repeated inoculations of gradually increasing doses of the toxin of the disease concerned, or from persons who have recovered from an attack of the disease and whose blood has, therefore, manufactured its own antitoxin.

The most familiar example of passive immunity is the use of antitoxin in the case of diphtheria. The creation of this form of immunity is made use of, either as a curative measure during an attack of the disease, or as a preventive measure, when there is risk of a person who has been exposed to infection contracting the disease. The immunity is brought about much more rapidly than the individual could himself manufacture antitoxin in his blood, but it is not of so long a duration. Of recent years measles and scarlet fever have also been treated by the injection of antitoxin, obtained from the blood of persons who have recently recovered from the disease concerned.

It is now possible to test persons for the existence of immunity against diphtheria and scarlet fever, these tests being known as the Schick test and the Dick test respectively. Such tests are of considerable value in times of epidemics, or where cases of one or other of these diseases have broken out in a school or institution, in finding out what children are susceptible to the disease in question.

The *Schick Test* for susceptibility to diphtheria consists of the introduction into the epidermis of a minute dose of the diphtheria toxin. In those susceptible, a slight local reddening of the skin occurs in 24 hours and this increases in intensity for the next three or four days. By means of this test, which is quite painless, it is easy to ascertain which children are susceptible to diphtheria, and in the event of an outbreak of this disease occurring in a class or department of a school, or in an institution, steps can be taken to render such children artificially immune by giving them a series of inoculations of diphtheria toxin on two or three occasions at intervals of a fortnight.

Such diphtheria immunity takes two or three months to develop, but lasts for a number of years and at least for the period of school life.

In the case of the *Dick Test* for susceptibility to scarlet fever, which is carried out in a similar manner to the Schick test, the reddening of the skin occurs in some 12 hours after the injection, and reaches its maximum in 24 hours. Immunization against scarlet fever can also be carried out in a similar manner to that used for diphtheria, by the injection of scarlet fever toxin, but the immunity produced, though not so certain as in the case of diphtheria, is more rapid in development.

Many Public Health Authorities have made arrangements whereby the immunization against these diseases can be carried out free of charge, at special clinics, institutions, or in the elementary schools

The immunity of the body to the attacks of invading organisms may be temporarily reduced by an ill-balanced dietary, particularly if it is deficient in vitamin content, by overwork, insufficient sleep, and adverse environmental conditions, such as overcrowding and ill-ventilation.

MODES OF INFECTION

BACTERIA may get access to the body in a variety of ways :—

(*a*) By the ALIMENTARY TRACT. In the mouths and throats of all individuals are vast numbers of bacteria, which fortunately do no harm in the majority of cases, though if a person should be run down in health, there is always a possibility that the bacteria may cause disease. Dental decay and tonsillitis are examples of diseases caused by their action. Typhoid fever, which is now rare in this country, owing to the success of the precautions taken to safeguard the water supply, is usually caused by drinking infected water, or by eating shellfish taken from sewage-polluted waters. Cholera, which is prevalent in tropical countries, is also spread by infected water supplies. Infected milk may cause such diseases as summer diarrhœa, tuberculosis, and scarlet fever.

The rôle of flies in causing disease is important, because of their filthy habits of alighting on ashpits, refuse heaps, excreta, etc., and then coming into the houses to walk over and feed on any food left uncovered.

(*b*) By the RESPIRATORY TRACT. A number of the communicable diseases are contracted by breathing infected air, *e.g.* diphtheria, measles, whooping cough, mumps, scarlet fever, smallpox, influenza, common colds, pneumonia, tuberculosis, acute anterior poliomyelitis (infantile paralysis), and cerebrospinal meningitis.

The most common mode of infection by the respiratory tract is by means of "*spray infection*" or "*droplet infection.*" In ordinary conversation expired air is propelled for a distance of some 2 or 3 feet, but in singing, shouting, coughing, and sneezing, the expired air may reach to many times this distance. Massive droplet infection, as in the case of a child suffering from measles, can be minimized by well ventilating the classrooms, not overcrowding them, and by well spacing the desks. In dormitories, when infection is feared, the beds should be placed, alternately, head to foot.

(*c*) By the SKIN. Although the skin acts as a barrier to the access of bacteria, it is frequently being abraded or receiving minute punctures through which bacteria can gain access.

As examples of infection through the skin there may be mentioned boils, carbuncles, pustules, abscesses, and impetigo.

Of the more serious conditions which can be caused by infection through the skin are tetanus and septicæmia (blood poisoning).

Certain bacterial diseases can also be introduced into the body by the bites of insects, *e.g.* tropical diseases, such as yellow fever, sleeping sickness (this tropical disease must not be confused with encephalitis lethargica, which is popularly known as sleepy sickness, cases of which occur in this country), typhus fever, which can be spread by body lice, or plague, which is spread by rat fleas.

(*d*) The organisms of venereal diseases gain access to the body via the GENITAL PASSAGES.

A not uncommon mode of infection, through the alimentary canal or the respiratory tract, is through the medium of so-called *carrier* cases. These are apparently healthy persons who, though showing no symptoms of the illness, harbour the disease-producing micro-organisms. Such persons probably have acquired an immunity, either as a result of a previous definite attack of the illness concerned, or in consequence of having had, at some time or other, a mild but unrecognized infection. In the case of diphtheria or typhoid fever, "carriers" have been definitely proved bacteriologically to have been the means of spreading infection, and though undemonstrated bacteriologically, it is almost certain that in the case of scarlet fever, and possibly other infectious diseases, carriers also play an important part in spreading them.

Infection may also be spread by means of fomites, that is, any articles which have been in close contact with an infected person and have not been disinfected, such as clothing, bedding, carpets, books, toys, etc.

In all the infectious diseases, after the infection has been introduced into the system there is an interval of time before the symptoms manifest themselves. During this interval, which is known as the *incubation period*, the bacteria are rapidly multiplying in the body and developing their toxins, which eventually get into the blood stream and give rise to the characteristic symptoms of the particular disease concerned. The duration of the incubation periods of the different infectious diseases varies, the shortest being about two days, as, for example, in certain cases of scarlet fever, but in typhoid fever or mumps the incubation period may be as long as three weeks.

A knowledge of the incubation periods of the different infectious diseases is important, as thereby it is known how soon any new cases may be expected to develop, and for what length of time individuals who have been exposed to infection should be kept under observation, and for how long hospital wards, convalescent homes, or other residential institutions in which infectious cases have occurred, should be placed in quarantine. The term *quarantine* is derived from a French word meaning 40, since formerly all persons on ships on which a dangerous infectious case had occurred, or which had come from an infected port, were prevented from communicating with the shore until the lapse of 40 days.

So far as school children are concerned the term quarantine is applied to the period of time for which they should be excluded from school, if there is a case of infectious disease in their homes.

THE COURSE OF THE DISEASE

THE progress of an attack of an infectious disease may be considered as passing through the following stages :—

(1) *The period of incubation,* which extends from the time of entrance of the organisms into the body until the occurrence of the first signs or symptoms of illness.

(2) *The period of invasion,* which is usually evidenced by some of the following signs or symptoms : headache, shivering, vomiting, convulsions, furred tongue, thirst, drowsiness, an increased pulse rate, rise of temperature evidenced by the flushed appearance and hot dry skin.

(3) *The period of advance,* at which stage the signs characteristic of the particular disease manifest themselves, such as the strawberry tongue and rash in scarlet fever.

(4) *The period of decline,* when the symptoms are abating and the temperature and pulse rate are returning to normal.

(5) *The period of convalescence,* during which normal health is gradually becoming restored.

Some types of infecting organisms remain at their site of entry and do not enter the blood stream, for example diphtheria bacilli usually remain localized to the throat, where they secrete their toxins, but these gain access to the blood stream and produce that feeling of serious indisposition which is referred to as *toxæmia,* in contradistinction to the term *septicæmia,* which implies that the bacteria themselves have gained access to the blood stream.

Immediately after gaining access to the body tissues the invading organisms commence to multiply rapidly and secrete their toxins, but at the same time the body defences are being manufactured and mobilized for the purpose of destroying the invaders and neutralizing their toxins.

The " period of decline " heralds the victory of the body defences, but such a conquest has not been achieved without the invaders causing some damage to the tissues and the " period of convalescence " covers the time taken for repairing this damage. For this reason children convalescing from whooping cough or measles are more susceptible to contracting pneumonia or tuberculosis, and after scarlet fever there is a definite risk of their developing an inflammation of the kidneys. For such reasons special care must be taken during convalescence.

SPREAD OF INFECTIOUS DISEASES

When a few cases occur in a school or institution, or in a localized area of a town, such outbreaks are spoken of as being "sporadic." When, however, the number of cases considerably exceeds the average there is said to be an "epidemic."

Whether the number of cases of infectious disease assumes epidemic proportions or not depends upon the number of susceptible persons in the community and upon the virulence of the infecting organism, which varies from time to time.

There seem to be seasonal variations in the prevalence of infectious diseases, the prevailing weather appearing to have some influence: thus influenza and pneumonia are usually more prevalent in the first quarter of the year, whooping cough about March and April, diphtheria and scarlet fever about the last quarter of the year, measles in May and June, and again at the end of the year.

DISINFECTION

THIS term means the killing of the infecting organisms by artificial means, such as by the use of chemicals in liquid or gaseous form, or by means of a steam disinfector.

Formerly it was thought that infection was largely disseminated by means of furniture, walls, and the air with which an infectious person had been in contact, and consequently the preventive measures adopted were chiefly concentrated upon meticulous disinfection of such surroundings. But as a result of the discovery that "carriers," "missed cases" and "droplet infection" are the main causes, it is now realized that the implicit trust placed in the past in disinfection as a safeguard against further infection was not justified.

Public Health Departments still continue to receive request for the disinfection of school premises and desks, etc., because one or two cases of infectious disease have occurred amongst the children of the school. Teachers can feel reasonably assured that their school premises will not be a source of infection if they see that they are kept clean by means of soap and water, and that the rooms are kept well flushed with fresh air by opening wide the windows.

LEGAL POWERS OF CONTROL

THE following provisions of the Public Health Act, 1936, are of interest to teachers :—

Sec. 144 makes certain infectious diseases compulsorily notifiable to the Medical Officer of Health by the head of the household.

Sec. 148 makes a person liable to prosecution if he exposes himself or a child under his care in any public place whilst suffering from a notifiable infectious disease. Or, if any person disposes of infected bedding or clothing.

Sec. 150 empowers the Medical Officer of Health to exclude from attendance at school infectious children or contacts.

Sec. 151 requires Head Teachers, on the request of the Medical Officer of Health, to furnish him with a complete list of the names and addresses of the scholars.

Sec. 155 prohibits the taking out of library books to, or their return from, infected households. Any person having such books must notify the local authority.

CHAPTER 10

SPECIAL INFECTIOUS DISEASES

Scarlet Fever. Diphtheria. Measles. German Measles. Whooping Cough. Mumps. Chickenpox. Smallpox and Vaccination. Encephalitis Lethargica. Infantile Paralysis. Influenza. Outbreaks of infection in schools. Exclusion periods for Infectious Diseases.

SPECIAL INFECTIOUS DISEASES

SCARLET FEVER (*Scarlatina*). In the larger towns this disease is endemic, that is, constantly present, but from time to time, approximately every three or four years, it gives rise to epidemics of greater or less severity.

The disease is probably caused by an organism known as the streptococcus scarlatinæ, which is thought to gain access through the tonsils.

The onset, which is usually sudden, commences with headache, vomiting, shivering, and a sore throat, the face is flushed, and the skin feels hot and dry, and the child is feverish. Any child exhibiting such symptoms at school should accordingly be immediately sent home as a suspected case. A rash, which is characteristic, usually appears within 24 hours, the skin being uniformly reddened, whilst there are also numerous deeper red pin-point spots. The rash never affects the face, but round the mouth there is often, in contrast to the flushing elsewhere, an unusual pallor. The tongue at first is covered with a thick white fur, through which soon the red papillæ of the tongue project ; in a few days the fur disappears and the tongue appears red and glazed, and with the projecting red papillæ the appearance of the surface of the tongue so resembles that of a strawberry, that the term " strawberry tongue " is applied to it. The uvula, soft palate and tonsils are red and swollen, and the glands under the jaw become enlarged and tender.

During the second or third week after the onset, desquamation or peeling of the skin commences, usually beginning on the lobes of the ears and the sides of the neck or chest. This desquamation varies in degree from a slight powdering of the epithelium to extensive flaking. An uncomplicated case may usually be regarded as free from infection after four weeks.

The chief complications of the disease are infection of the middle ear, which sometimes leads to suppuration, septic glands in the neck, inflammation of the kidneys (nephritis), rheumatism, and occasionally valvular disease of the heart.

An attack of scarlet fever may be so mild that the parent fails to recognize it as such and so does not call the doctor in, and after only a few days' absence the child may return to school apparently well, though still in an infectious state. Such mild unrecognized cases, or " missed cases " as they are usually termed, are sometimes the cause of outbreaks in schools.

" Droplet infection " is the commonest method of infection, but the discharge from the nose or ears of children who are suffering from the disease or are convalescent after it can also spread the infection. It is also probable that occasionally indirect infection may occur through the medium of infected pens, pencils, clothing, drinking and eating utensils.

Outbreaks attributable to the milk supply becoming infected are reported from time to time.

DIPHTHERIA. This disease, which is due to the diphtheria bacillus, is characterized by a sore throat, associated with the development of a greyish-white membrane on the tonsils and soft palate, and enlargement of the lymphatic glands in the neck. Though the disease is a serious one the onset is not usually acute, the child merely not feeling or looking well.

Sometimes the disease affects the larynx, and the formation of the membrane in it may so seriously interfere with the breathing as to necessitate the operation known as tracheotomy (the opening of the trachea and the insertion of a tube to facilitate breathing).

Diphtheritic infection of the nose may also occur, and this is usually much milder and more chronic than the other forms, being characterized by a watery or purulent discharge from the nostrils which appear red and are sometimes sore and crusted. This is an important variety from the teacher's point of view, since unrecognized cases of nasal diphtheria are sometimes responsible for outbreaks in schools. Cases of reddened and discharging nostrils should, therefore, always be regarded with suspicion, especially if diphtheria be prevalent, and the attention of the school medical officer should be drawn to any such case immediately.

The danger of diphtheria is mainly due to the toxins which the bacilli manufacture and which get into the circulation and may cause muscular paralysis which may be fatal in the event of the heart muscle becoming affected. Sometimes the eye muscles, or muscles of the palate become paralysed, causing squint or a nasal voice. The severity of the disease can be largely controlled by the prompt injection of antitoxin to neutralize the toxins before they can injure the nervous system and produce paralysis.

Measles, which is probably due to a virus, is a highly infectious disease, particularly in the first few days before the appearance of the rash. As the nature of the condition is often unsuspected, isolation is seldom carried out before the infected child has already infected others.

Epidemics of the disease appear to run in cycles of approximately two years, and as a rule last for a few months.

The first signs of the disease are those of a bad cold, with sneezing, a running nose and congestion of the eyes, and a short, dry cough, and it is by the sneezing and the coughing that the disease is spread (droplet infection). On the fourth day the rash appears as numerous dusky, slightly raised spots, which soon run together into blotches. This rash, which gives the skin a mottled appearance, first comes out behind the ears, then on the face, especially on the forehead, and spreads downward over the whole of the body. Before the appearance of the rash on the skin, there may be sometimes seen on the inner side of the cheek small bluish-red spots, known as Koplik spots, by the presence of which it is often possible to diagnose the condition in the early stages.

With the appearance of the rash the child becomes very feverish and the temperature remains high for two or three days. By this time the catarrhal condition has spread down the bronchial tubes so that some bronchitis is usually present.

The complications of the disease include severe bronchitis, broncho-pneumonia, conjunctivitis, blepharitis, and middle ear trouble. The most serious of these is broncho-pneumonia, which is responsible for most of the deaths from measles. Usually the younger the child who contracts measles the more serious is the disease.

After an attack of measles the child is often left in a debilitated condition and liable to chest trouble and enlargement of the glands, and sometimes particularly susceptible to infection with tuberculosis.

A recent development in the prevention and the treatment of the disease is the production of a passive immunity by the injection of serum taken from convalescent patients.

German Measles. This is a much milder disease than measles, there being usually very little constitutional disturbance. Often the first and only indication of the disease is the development of a rash, which is sometimes like the scarlet fever rash, but differs from it by appearing also on the face, by being of short duration only, and in not being followed subsequently by " peeling." The rash is occasionally somewhat patchy, like the measles rash, but there are no marked catarrhal symptoms, as in measles. The glands at the back of the neck are usually enlarged, thus differentiating it from both scarlet fever and measles.

Whooping Cough is mostly a disease of very young children and, as in the case of measles, it is spread by droplet infection, and the younger the child attacked the more dangerous is the disease. The causative organism is considered to be a bacillus.

The disease starts as an ordinary cough, later becoming paroxysmal in nature. The characteristic whoop does not usually develop until about a week after the onset. During a typical paroxysm the child makes a number of successive staccato-like, forcible expirations without any inspirations. In consequence the child gets livid in the face, the eyeballs protrude, and the tongue is pushed out. The child then takes a forced inspiration with the glottis partly closed, which is the cause of the typical whoop from which the disease gets its name. After the whoop the paroxysm usually ends by the child vomiting.

As a result of the violent explosive efforts made in coughing, there not infrequently occurs an ulcer on the frænum under the tongue, brought about by the continual chafing against the lower incisor teeth. The violent coughing is also apt to cause a rupture. It is not unusual for children suffering from this disease to become malnourished, partly owing to the fact that much of the food taken is vomited up again during the paroxysms. Broncho-pneumonia is another important complication.

The debilitated condition in which children recovering from this disease are often left makes them particularly susceptible to tuberculosis.

For some considerable time after children have recovered from this disease they are liable to recurrence of the whoop if they get attacks of bronchial catarrah. Whooping in such circumstances does not mean, however, that there is a relapse of the whooping cough, and there is accordingly no need for the child's exclusion from school on this ground.

Mumps, which occurs mostly in children of school age, is not a serious condition and is due to an inflammation of the salivary glands, usually the parotids. The disease has a sudden onset and the acute stage lasts about a week. It commences as a painful swelling in front of, below, and also sometimes partly behind, one or both ears, the skin over the swelling being tense.

The disease is often confused with a swelling of the face caused by decayed teeth, or with enlarged glands of the neck resulting from tonsilitis, decayed teeth, or diphtheria.

Chickenpox is highly infectious but rarely dangerous, there often being little or no constitutional disturbance, the rash being the only evidence of the disease. This appears first on the trunk in the form of raised spots (papules), which rapidly become vesicular (water blisters), and in the course of a day or two it spreads to the face, scalp, and limbs. For several days successive crops of vesicles occur.

Owing to the possibility of its confusion with smallpox it is usual to make the disease notifiable to the Medical Officer of Health when smallpox is prevalent in the community. The micro-organism causing the disease has not yet been discovered.

Smallpox. Prior to the introduction of vaccination this was a very common disease among children. It is one of the most highly infectious diseases known, and apart from infection by contact it can be spread by means of fomites, that is, infected bedding, clothing, etc. Cases are now seldom seen amongst children owing to their immunity consequent upon vaccination, but the disease is more prevalent amongst the middle aged, when the immunity following vaccination in childhood has passed off.

The first symptoms of the disease are shivering, fever, and intense pain in the back. On the third day of the illness a rash appears, which varies considerably in appearance according to the severity of the type of the disease prevalent at the time, and the degree of susceptibility of the person attacked. The rash is deep-seated in the skin, and at first appears as spots, or papules as they are called, which feel like small shot embedded in the skin ; most of these papules later change into vesicles (blisters) which subsequently become pustular.

A characteristic of the smallpox rash is its *centrifugal* distribution over the body, that is the further away from the centre of the body, the more numerous are the spots.

This is an important point in differentiating the disease from chickenpox, with which it is often confused. In chickenpox the rash is *centripetal* in distribution, the spots being more numerous towards the centre of the body than they are at the extremities.

Vaccination. At the close of the eighteenth century, Edward Jenner, a Gloucestershire physician, observed that dairymaids seldom contracted smallpox, but frequently caught from the cows a localized skin condition known as cowpox, the spots of which closely resembled the vesicles occurring during a mild attack of smallpox. It occurred to Jenner that cowpox was probably a modified form of smallpox and it was for this reason that the dairymaids who contracted cowpox escaped the more virulent disease smallpox. To test out his theory he inoculated a boy with the material obtained from a vesicle from the hand of a dairymaid who had contracted cowpox. Some weeks later he inoculated this boy with material obtained from a smallpox patient, but the boy failed to contract smallpox. Though Jenner's discovery at first met with considerable opposition, especially from the medical profession, further experiments eventually proved that his theory was correct, and subsequently, in 1853, vaccination within three months of birth was made compulsory. Subsequently several Vaccination Acts were passed, the latest being the Vaccination Act of 1907, under which vaccination is still compulsory unless a

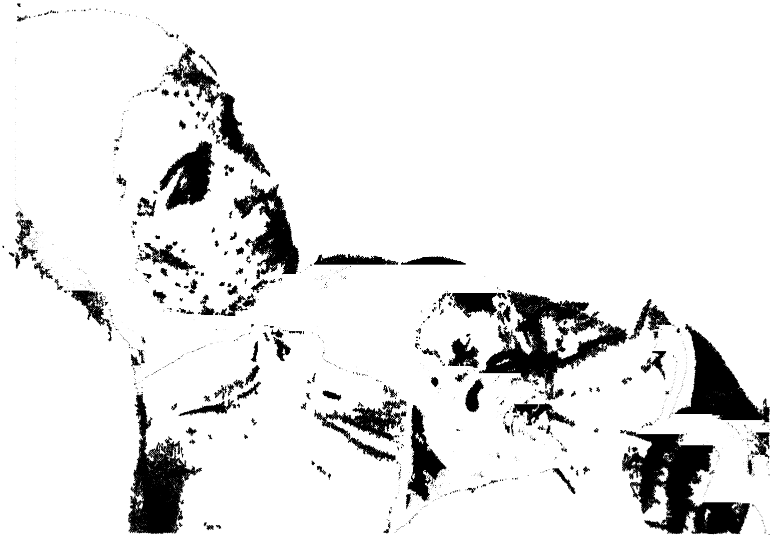


FIG. 30. *A mother suffering from a mild attack of Smallpox uith her vaccinated baby, who escaped the disease.*

(Photo kindly supplied by Dr. W. Hanna.)

parent makes a " Statutory Declaration " before a Commissioner of Oaths or Justice of the Peace that he conscientiously believes that vaccination would be prejudicial to the health of the child.

When vaccination was first introduced the lymph used was obtained from the arms of other children who had recently been vaccinated, but the present practice is to obtain the vaccine lymph from healthy calves which have been inoculated with the virus, the lymph from the calves being kept in glycerine. The calves are killed two days after the virus has been taken from them, and if there is any cause for suspecting that any one is diseased, the batch of lymph obtained from the suspected calf is destroyed.

The extreme precautions and care which to-day are taken in the preparation of lymph for vaccination purposes render the possibility of injurious effects from its use extremely remote.

In the Vaccination Order of 1930 issued by the Minister of Health to public vaccinators, it was laid down that in all ordinary cases only one small linear scratch was for the future to be made when vaccinating children. Vaccination with one mark only does not, however, confer the same degree of immunity as was formerly obtained when several marks were made, and it is desirable, therefore, that children vaccinated in infancy by this modified method should be again vaccinated at the ages of 5 and 14.

ENCEPHALITIS LETHARGICA, which is popularly known as " sleepy sickness," must not be confused with " sleeping sickness," which is a disease of the tropics, occurring chiefly in Africa.

Encephalitis lethargica affects the nervous system, producing at the onset delirium, drowsiness and paralytic symptoms, the organism causing it being probably a virus.

After recovery from the acute stage of the illness the child may be affected in various peculiar ways. The character may be entirely altered, so that children previously well-behaved may become petulant, hot-tempered, disobedient or impertinent. At school they may become inattentive and suddenly leave their desks and wander aimlessly about the classroom. In more marked cases they may spit about the house, use foul language on the slightest provocation, or pilfer. In extreme cases, fortunately rare, moral control is almost entirely lost, and they become violent, abusive, liars, thieves, and vagabonds, so that their parents are only too glad for them to be removed to a suitable institution.

Another after-effect is the inversion of the sleep rhythm, so that they sleep during the day and are wide awake at night, when they may whistle or sing and keep the rest of the household awake.

Acute Anterior Poliomyelitis, which is caused by a virus and is only very slightly infectious, occurs mostly during the summer months, children under five years of age being the chief sufferers. Inflammation of the grey matter of the spinal cord occurs, resulting in the destruction of certain of the motor nerve cells, and thus causing paralysis of groups of muscles supplied by the nerve cells affected. In cases of this disease it is usually some of the muscles of the arms or the legs which are involved, and many of the children are so badly crippled as to need education in special schools for the physically defective. The paralytic condition resulting from an attack of acute anterior poliomyelitis is known as infantile paralysis.

Influenza. From time to time almost world-wide epidemics of this disease have raged, resulting in a large number of deaths. Several organisms have been described as being the cause of the condition, but no one definite causative organism has yet been discovered. All members of the population appear to be highly susceptible to influenza, and in consequence the disease spreads with extreme rapidity, almost always by droplet infection.

The onset is usually very sudden and is characterized by feverishness, extreme mental depression and physical exhaustion. Three clinical varieties of this disease are known, namely, the respiratory, nervous, and gastric types. In the first, the symptoms are chiefly those of a respiratory catarrh, with a special tendency towards the development of pneumonia, particularly in elderly people. In the nervous variety, such symptoms as headache, backache, sleeplessness and mental depression predominate. In the gastric type, in addition to the general symptoms of influenza, vomiting and diarrhœa occur, and in recovering from the acute condition the patient may suffer from digestive trouble for some months.

Unfortunately there is very little that can be done to combat an outbreak, but at such times the importance of droplet infection should be borne in mind and every precaution taken when coughing and sneezing. All singing in schools should at such times be temporarily suspended.

It is a well-recognized fact that the worse the ventilation the greater the chance of infection, and therefore teachers, at times of epidemics, particularly epidemics of influenza, should use the available ventilation to its fullest capacity. Attendance in crowded buildings, such as cinemas or in crowded vehicles, should at these times be avoided as much as possible.

CONTROL OF OUTBREAKS OF INFECTION IN SCHOOLS

It is not necessary to give in detail the steps usually taken to deal with school outbreaks of all the different infectious diseases, but as an indication of the lines on which this is undertaken, the procedure usually adopted in three of the more common infectious diseases, namely, diphtheria, scarlet fever, and measles, are given :—

SCARLET FEVER. It is not often that this disease becomes epidemic in schools, outbreaks in schools being usually confined to one or two classes, and are nearly always attributable to the presence of one or more "missed cases." Enquiries should, therefore, be made whether any children have been absent from school on account of sore throat, and have returned after being away for only a few days. Such children should be specially examined by the medical officer, and the rest of the children in the classes concerned examined for any evidences of peeling, enlarged glands in the neck, or discharge from the nose or ears.

The children can be tested for susceptibility by means of the Dick test, and susceptible children immunized, if the parents are willing. The above procedure usually proves sufficient, and school or class closure is hardly ever required.

DIPHTHERIA. If several cases of this disease have occurred in a class or department of a school, all children complaining of sore throats should be at once excluded from school and either the School Medical Officer or Medical Officer of Health informed. In view of the possibility that the outbreak may be due to the presence in school of one or more " carrier cases " or of mild unrecognized cases of the disease (missed cases), the usual practice is for a medical officer to visit the school and make enquiries as to whether any children during the previous few weeks have had sore throats. He would examine all the children in the affected classes, paying particular attention to such points as nasal discharge, sore nostrils, running ears, enlarged glands in the neck or a recently developed nasal voice, which is highly suggestive of a diphtheritic paralysis of the palate muscles.

The bacteriologist can be of considerable assistance in the discovery of missed or carrier cases, by cultivating and examining the bacteria obtained by the medical officer from the throats or noses of suspected persons. For this purpose the throat or nose is brushed with a swab, which consists of a piece of sterilized wool wrapped round the end of a rod and kept in a sterilized test tube. The bacteriologist rubs the swab on solidified blood serum in a glass tube, and places the tube in an incubator over night. By the following morning any diphtheria bacilli which may have been present on the swab will have multiplied enormously on the serum in the tube, and can then be easily recognized under the microscope.

The Schick test can with advantage be utilized for ascertaining which children are susceptible, and the offer can then be made to the parents of such children to have them immunized by inoculation. Finally, it should be borne in mind that infection may be spread by infected pens and pencils, which should, therefore, be disinfected, and if there is a common drinking-cup this should be temporarily removed.

It should seldom be necessary to close a class or department on account of diphtheria.

Measles. As it is usually not possible definitely to diagnose a case of measles until the appearance of the rash on the fourth day of the illness, teachers should, when measles is prevalent in the neighbourhood, be on the watch to detect any children manifesting the early symptoms such as sneezing, running of the eyes, etc., and should send these children home at once in order to prevent as far as possible any spread of infection in the school. The risks of a spread in a class depend chiefly upon the number of susceptible children in it, and upon the adequacy of the ventilation, the disease being much less likely to spread in a well-ventilated classroom.

School nurses, who have had experience of infectious diseases, can be advantageously employed during an outbreak of measles in a school, to pay frequent visits to the school to look for suspicious cases. Some authorities employ special measles nurses, or in times of epidemics, divert some of the health visitors or school nurses from their ordinary duties to visit the homes of cases in the poorer neighbourhoods to assist in the nursing.

The closure of schools or departments for measles is now seldom resorted to, as it is not considered to be of much value in controlling an outbreak, with the possible exception of schools serving sparsely populated districts, where the children would have small chance of coming in contact with one another, except at the school.

The usual practice adopted is to exclude from school all contacts from the same household who attend the infants' department, and also the older children who have not had the disease.

In this connection it is of considerable assistance to have readily available at the school an up-to-date record with regard to the particular infectious diseases from which each child in the school has suffered.

On the original admission of a child to school, the Head Teacher should obtain from the parent information concerning the child's infectious disease history and enter this either on the Medical Inspection Schedule card or elsewhere, and when children are away from school on account of having contracted an infectious disease, this fact should be noted on their cards. Such records are of special value in the case of measles, as, during an outbreak, the decision may be made to exclude temporarily from attendance the children who have not had the disease.

In 1925 the Ministry of Health and Board of Education jointly issued a pamphlet entitled " Memorandum on Closure of and Exclusion from School," in which a table was given, giving the Incubation and Exclusion Periods of certain Infectious Diseases, along with some explanatory remarks. These remarks and the Table are given on the following pages.

Teachers can assist in preventing the spread of infectious and contagious diseases by impressing on the minds of their children such hygienic precepts as the value of fresh air, exercise, sleep, and the care of the skin, hair and clothing ; by instituting handkerchief drill for the Juniors, and teaching them always to cover their mouths when coughing and never to put pens and pencils in them ; by seeing that the children make proper use of the cloakrooms, etc. ; and if possible bring their own brushes, combs and towels.

When infectious diseases are prevalent teachers should be on the alert for cases of sore throats, rashes and colds. Singing lessons should be suspended and the classroom kept well ventilated. A knowledge of the incubation periods and symptoms will be of value in possibly detecting early cases, while children who return to school after a few days absence should be regarded with suspicion as being possibly " missed cases."

INCUBATION AND EXCLUSION PERIODS OF THE COMMONER INFECTIOUS DISEASES

Disease	Incubation Period	Interval between onset of illness and appearance of rash	Period of Exclusion.	
			Patient	Contacts.
Scarlet Fever	1–8 days	1–2 days	Two weeks after return from hospital, or, in the case of patients treated at home, two weeks after release from isolation.	One week after removal of patient to hospital, or, in the case of patients at home, one week after release from isolation
Diphtheria	2–10 days	—	Two to three weeks after end of attack; or until pronounced free from infection by a medical practitioner	Two weeks after removal of patient to hospital or, in the case of patients treated at home, ten days after release from isolation. Negative swabs should be obtained.
Measles	7–14 days	4 days	Three weeks from date of appearance of rash.	Infants, and other children who have not had the disease, three weeks from date of onset of last case in house.
German Measles	5–21 days	0–2 days	One week from date of appearance of rash	Infants, and other children who have not had the disease, three weeks from date of last exposure to patient with rash.
Mumps	12–23 days	—	Until one week after subsidence of swelling.	No exclusion

Disease.	Incubation Period.	Interval between onset of illness and appearance of rash.	Period of Exclusion.	
			Patient.	Contacts.
Whooping Cough	6–18 days	—	Six weeks from commencement of cough.	Infants only, for six weeks from date of onset of last case, or three weeks from date of last exposure to infection.
Chicken Pox	11–21 days	0–2 days	Three weeks, or until all scabs have disappeared.	Infants, and other children who have not had the disease, three weeks from date of last exposure to infection.
Small Pox	10–14, but usually 12 days	3 days	Six weeks, or until the patient is certified free from infection by a medical practitioner.	Sixteen days, unless recently vaccinated. when exclusion is unnecessary.

It should be understood, when this table is used, that infectious disease is a process, not an entity, and that the process is liable to modification by many circumstances, such as the intensity of the infection, and the condition and resistant power of the body. As human beings vary in their general and special characteristics, it is probable that in no two persons will the process be precisely similar. The visible signs, by which alone the disease is manifested, are accelerated or retarded, accentuated, diminished or suppressed in accordance with these conditions. The periods indicated in the second and third columns of this table should therefore be regarded as approximate only, and liable to variation.

CHAPTER 11

TUBERCULOSIS

Varieties of the tubercle bacillus. Immunity. Pulmonary tuberculosis. Non-pulmonary tuberculosis. Methods of dealing with the disease.

TUBERCULOSIS is one of the oldest known diseases, and history records that the lives of many illustrious persons have been cut short by its ravages. In the seventeenth century it was so prevalent and hopeless in its outlook, that Bunyan referred to it as one of the " Captains of the Men of Death ". Little or no progress was made either in the prevention or the cure of the disease until after Koch, in 1882, had discovered that the disease was caused by a minute bacillus which he named the tubercle bacillus. Later it was found that there are two varieties of this bacillus which can convey the disease to man, known respectively as the *human type* and the *bovine type*, which most commonly affects cattle. The former type is largely responsible for pulmonary tuberculosis (phthisis) in adults and less commonly in children. The latter type, which is common in children and only occasionally affects the lungs, is the cause of tuberculous affections of the other tissues of the body, such as the glands, bones and joints.

In many of the cases of phthisis, particularly in the advanced cases, the sputum contains large numbers of tubercle bacilli, and patients may infect others by coughing (droplet infection), or by their sputum becoming dried, turned into dust, and then being inhaled.

It has been found that the bacilli can resist drying and freezing for long periods: on the other hand exposure to sunlight rapidly kills them.

The bacilli may also gain access to the system through the tonsils or the alimentary canal, usually as the result of drinking milk obtained from cows with tuberculous udders. It has also been suggested that another possible source of entry is through decayed teeth.

It has been estimated that 6 per cent. of all deaths from tuberculosis are cases of bovine origin, and that about 4,000 fresh cases of bovine infection occur annually, which are responsible for an immense amount of invalidity, suffering, and permanent deformity.

Tuberculosis may affect people at any time of life. In children the disease usually commences in pre-school life, especially between the ages of 1 and 3, and is chiefly of the non-pulmonary form. Infection of the glands of the neck is especially common, and is the result of bovine infection; tuberculous meningitis is a serious form which is responsible for half the tuberculosis deaths amongst children.

Between the ages of 5 and 15 the incidence of tuberculosis is less than at any other period, but between 15 and 25 the incidence rapidly increases, from which age, in the case of women, the prevalence steadily declines, but in the case of men the incidence still further increases up to the age of 45, after which it steadily declines.

The disease is not hereditary, though many consider that the delicate, fragile and fairy-like type of children with long eyelashes, who often have downy hair between the shoulder blades are particularly susceptible to infection, but this view is not generally accepted. All children are, however, liable to infection until an acquired immunity has been developed, as the result of recurrent small doses of the infection, which, though not large enough to produce definite disease, are sufficient to stimulate the natural defensive processes of the body, whereby immune substances are formed in the blood, some of which attack the bacilli and others neutralize their toxins. Though there can be no question that a partial immunity is usually acquired, it is doubtful whether complete immunity is ever established. It is therefore important, in order that such immunity as has been acquired shall not be diminished, to adopt a healthy mode of living, particularly with regard to the sufficiency and suitability of food, a proper amount of rest, exercise, and fresh air, and avoidance of overcrowding. Persons who live and work in ill-ventilated rooms are much more susceptible to the disease than those who live in well-ventilated rooms or lead an open-air life.

Other conditions that diminish resistance in children are repeated colds, measles, influenza, bronchitis, pleurisy, pneumonia, malnutrition, whooping cough, anæmia, etc. It will be convenient to discuss the different types of tuberculosis under two main headings, the pulmonary and the non-pulmonary varieties.

PULMONARY TUBERCULOSIS.

THE symptoms of this form of the disease show a certain amount of diversity in their manifestations. Cough is usually an early and important symptom, especially if it persists or follows an attack of influenza. Constant fatigue, perspiration after slight exertion, loss of weight and appetite, and a disinclination to play, should call for investigation. When tuberculosis is the cause, such symptoms, together with slight rises of temperature and night sweats, are attributable to the effects of the toxins of the tubercle bacilli.

The diagnosis, which is often very difficult, is determined by a careful consideration of the symptoms taken in association with the findings of a physical examination. A bacteriological examination of the sputum, if there be any, is also of considerable assistance. As a further aid to diagnosis, use is often made of a tuberculin test known as the "Mantoux" reaction. In this test a diluted solution of tuberculin, which is a toxin derived from the bacilli, is injected into the skin. If no reaction takes place, tuberculous infection can be practically ruled out, but if a positive reaction takes place, as evidenced by a reddening of the skin around the site of injection, this is an indication that tuberculous infection has at some time or other occurred. In the case of children the reaction may be of great significance, especially when associated with other evidence, such as recent exposure to infection or the presence of suspicious symptoms.

With regard to treatment, it is always advisable for pulmonary cases to be sent to a sanatorium as soon as possible after a diagnosis has been arrived at. In such an institution the children are kept under constant medical supervision, and their mode of life is so regulated as to give them the best chance of developing an immunity. The children live under open-air conditions, where exposure to moving air and sunlight reacts beneficially upon the skin and improves the metabolism. They are also supplied with a first-class diet, and rest and exercise are carefully regulated according to their physical condition. When the children are convalescing it has been found that a certain amount of education, by interesting and occupying their minds, is actually beneficial in expediting their recovery, and in some sanatoria therefore, a sanatorium school has been provided.

A further important part of sanatorium treatment is to educate the children how subsequently to lead a hygienic life in their homes.

After discharge from sanatoria, it is the practice to keep all children under the regular supervision of the tuberculosis officer until there is no longer any risk of a relapse of the disease.

NON-PULMONARY TUBERCULOSIS

Though the tubercle bacillus may attack almost any organ or tissue in the body, the most commonly affected are the peripheral lymphatic glands, the bones and joints, abdominal lymphatic glands and peritoneum, the meninges and the skin, in the order named. Of the peripheral glands, the most frequently involved are those in the neck which drain the tonsils and nasopharynx. The affected glands become enlarged and occasionally break down and form abscesses which will require operative treatment. In the earlier stages the children are not actually ill, and are able to attend day open-air schools, where the fresh air and good feeding help to restore health. In the more advanced cases treatment by ultra-violet rays or at a sanatorium may be necessary.

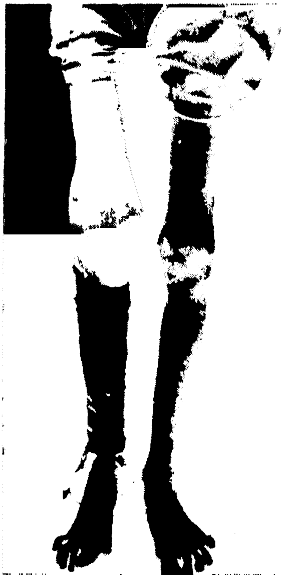


FIG. 31. *Tuberculosis of the Knee-joint.*

The most commonly affected joints are the spine, hip, knee, and ankle. At the onset there is usually some swelling and intermittent pain, in consequence of which the movement of the joint becomes limited, and the child keeps the joint rigid in the most comfortable position, and in the case of a lower limb being affected a limp is usually present. The treatment of these joint cases can best be carried out at a special sanatorium or orthopædic hospital for some two or three years, where the hygienic mode of life is similar to that required for pulmonary cases, but special attention is, of course, given to the joint affected.

Heliotherapy (sun treatment), which was originally introduced at the beginning of the century by Dr. Rollier, at Leysin in Switzerland, for the treatment of tuberculous joints, is now extensively employed. The patient's body

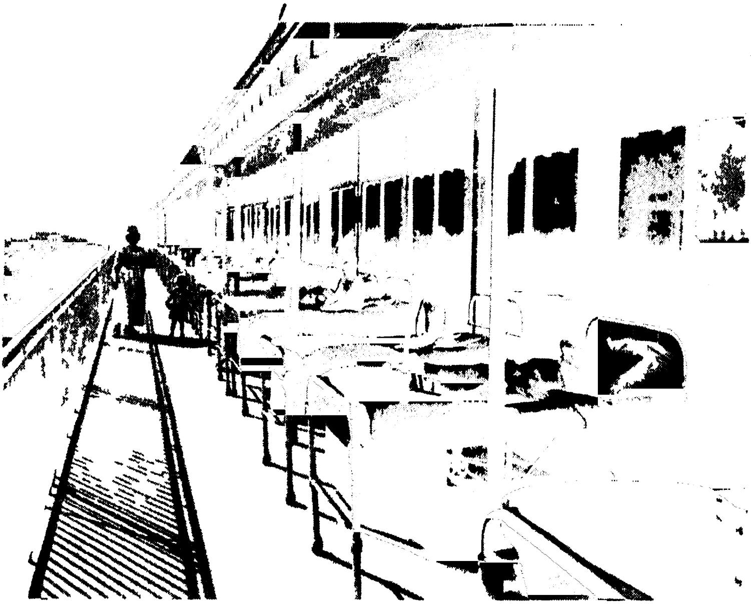


FIG. 32. *Heliotherapy at Leasowe Hospital*

(*By kind permission of the Liverpool Child Welfare Association*)

and limbs are exposed to the sun and air for several hours daily, but as individuals react differently to the action of sunlight the time of exposure has to be carefully regulated. Small areas of the skin are at first exposed for short periods, and the area of skin and the times of exposure are gradually increased according to the reaction of the skin and body to the sun's rays. The affected joint is also exposed to the sunlight.

A sanatorium usually has an open-air school attached to the institution. In some of the joint cases, after the disease has ceased to be active, the joint may remain stiff and some permanent deformity and disability result. A considerable proportion of these cases have to be provided for educationally in special schools for the physically defective, owing to the risk of injury to which they would be exposed if they were required to attend the ordinary schools.

Subsequent to discharge from hospital or sanatorium a certain amount of regular orthopædic supervision is needed for these cases, as some have to wear apparatus, such as a spinal support, or require alteration to the sole of the boot, when the affected leg is shorter than the other, or in some cases massage may be necessary. Such orthopædic supervision can be carried out at a school orthopædic clinic.

The following are the *official methods for dealing with tuberculosis* :—

(1) The compulsory notification of every case to the Medical Officer of Health by the doctor attending. By this means the Medical Officer is enabled to secure that all necessary steps are taken to trace the source of infection and to prevent the spread of the disease.

(2) The establishment by local health authorities of tuberculosis schemes, which usually comprise—

(*a*) The provision of tuberculosis clinics staffed by medical officers experienced in the diagnosis and treatment of the disease, the doctors being assisted by specially trained nurses who visit the patients' homes to advise as to the most hygienic mode of living, and to see that all necessary hygienic precautions are being carried out. To these clinics, cases can be sent by local practitioners for diagnosis, and some treatment may also be carried out there. After patients are discharged from sanatoria they are kept under regular supervision at these clinics.

(*b*) The examination of contact cases, that is, persons who are living in close association with the infected patient.

(*c*) The provision of hospital and sanatorium treatment.

After their discharge from sanatoria it is desirable that patients should at first take up light work in the open air and should only resume full employment gradually. This ideal, however, can seldom be achieved.

In order to overcome this difficulty Sir P. Varrier-Jones, Medical Director of the Papworth Village Settlement, together with the late Sir G. Sims Woodhead, established a settlement for ex-sanatorium patients and provided them with graduated work. In this village settlement there are well-ventilated workshops, suitably equipped with modern apparatus so that workers may manufacture goods which can be sold at ordinary trade prices. The patients themselves have erected most of the buildings in the settlement.

Model cottages have been built on the estate so that married men may bring their families and live in the settlement. It is interesting to note that none of the children born at the colony have, while living there, contracted any form of tuberculosis—a striking example of the protective value of a hygienic mode of living.

Public health authorities have done a great deal of preventive work which has materially helped in reducing the incidence of tuberculosis, by securing the adequate ventilation of work-places, the prevention of overcrowding, by providing better housing accommodation for the working classes, and by putting into force the Regulations passed to safeguard the milk supply.

In the case of children, the provision by education authorities of day and residential open-air schools are also playing no small part in preventing the disease. Adequately ventilated and well-lighted classrooms, the teaching of hygiene, the adoption of school milk schemes, the importance attached to physical exercises and games, and the provision of playing fields and school camps, are also of assistance in securing a higher standard of health.

CHAPTER 12

RHEUMATISM AND CHOREA

Prevalence and predisposing causes. Symptoms. Prevention of heart disease.

RHEUMATISM

RHEUMATISM is now commonly regarded as a general disease of infective origin, due to a micro-organism of the streptococcus variety, which many think enters the system through the tonsils.

Children are affected in a somewhat different manner from adults, definite joint affections being comparatively rare, but pains in the muscles and soft tissues of the limbs are common, the heart is frequently affected, and chorea (St. Vitus' Dance), which is a rheumatic affection of the nervous system, is practically confined to children.

The disease usually commences between the ages of 5 and 15, and particularly between 5 to 9. Girls are much more susceptible to the disease than boys, in the proportion of about 5 to 3.

An investigation in Liverpool in 1929 into 1,000 cases of rheumatism amongst school children, a similar number of non-rheumatic children being used as controls, showed that there was some slight evidence of a hereditary predisposition to the disease, and that dental sepsis was about twice as prevalent among the rheumatic children as among the controls, and enlarged tonsils were somewhat more frequent among the rheumatic cases. Certain unsatisfactory environmental factors were also probably predisposing causes, as the rheumatic children were found to have somewhat worse footgear, and reported as wearing damp clothes more frequently than the controls, whilst their housing conditions were also somewhat worse.

Rheumatism in children may manifest itself in several different ways. In acute rheumatism (rheumatic fever) the child is feverish, and at first complains of a pain in one joint, usually the knee, which becomes hot, red, swollen and tender to touch. The affection flits from joint to joint, and many may become involved in rapid succession. The way in which some of the inflamed joints quickly recover, whilst other joints are becoming involved, is a characteristic feature.

The acute stage may last about a week or ten days. In a considerable proportion of the cases the heart is affected in one or more of the following ways: The muscle may become affected and dilatation result; the outside membrane (pericardium) may become inflamed; or most frequently of all, the inner lining membrane (endocardium) become inflamed. This condition, which is known as endocarditis, usually involves the mitral valve, and often leads to its permanent damage and the serious impairment of its efficiency.

More frequently, however, rheumatism is insidious in its onset, the joint symptoms being often so slight that the parents take little or no notice of them, and regard them only as "growing pains." In this connection, however, Dr. Hawksley has pointed out that investigations into cases of supposed "growing pains" at a number of children's hospitals have shown that in the vast majority of these cases the curtailment of their activities and impairment of their education is not justified, since it is doubtful whether the majority of such pains are really rheumatic in origin and that, in any case, the heart very seldom becomes involved.

A characteristic of this less serious type of 'so-called "growing pain" is that it is more nagging and painful than a true rheumatic pain, and severe enough even to make many children cry. Moreover, in these cases, there is no rise in temperature or pulse rate, no anæmia or history of frequent sore throats. On the other hand, there is usually obtained a history of vague ill-health, emotional disturbance and physical or mental strain, whilst such postural and orthopædic defects as bad stance, scoliosis or flat foot are commonly associated.

CHOREA

CHOREA, which is a nervous manifestation of rheumatism, is often popularly referred to as St. Vitus' Dance, because it was formerly confused with cases of dancing mania, which occurred from time to time in epidemics, and were often cured by making a pilgrimage to the shrine of St. Vitus. This dancing mania, however, was really a form of hysteria, and not chorea at all.

Chorea is a disease of childhood, usually commencing between the ages of 5 and 15, and occurs at least twice as frequently in girls as in boys.

The most prominent characteristic of the disease is the jerky, irregular and purposeless movements of one or more groups of muscles. Thus, facial grimaces and irregular frowning and smiling may occur, the fingers may be opened and shut, or the wrists suddenly flexed or extended, or the shoulder jerked. These irregular movements are involuntary, and become more marked when voluntary movements are being carried out. If, for example, the child be asked to stretch out the hands, the jerking becomes more evident. Occasionally clucking noises are made with the tongue, and another tongue peculiarity is the " Jack-in-the-box " rapidity with which it is withdrawn after being put out.

Often the cases are of a much milder nature than described above, and the only history obtainable from the parent is that the child has commenced to pull faces, or become rather fidgety, or careless, or constantly to drop things.

The association of chorea with rheumatism is shown by the fact that in about half the cases there are definite

FIG. 33A. *Specimen of a boy's normal handwriting taken from his school exercise book.*

FIG. 33B. *Specimen of the same boy's handwriting ten weeks later. The deterioration in writing proved to be due to imperfect co-ordination of the hand muscles caused by rheumatic chorea.*

rheumatic manifestations, such as articular rheumatism, or heart disease.

The imperfect co-ordination of the muscles of the hands and arms leads to deterioration in the handwriting. The accompanying illustrations are two specimens of a boy's handwriting taken from his exercise book and submitted to the school medical officer by a head teacher, when reporting the case of a boy who had " recently changed considerably in some directions," and whose deterioration in writing was at first considered by his teacher to be due to indifference or laziness.

When the boy was examined it was observed that he was somewhat jerky in some of his movements, and it was ascertained that he had, for about two months, been dropping things. He complained of some pain in one ankle, which was found to be slightly swollen. The case was undoubtedly one of rheumatic chorea, and the boy was excluded from school, and referred to hospital for treatment.

The upper specimen is a sample of the boy's normal writing, and shows a marked contrast with the bad writing in the second specimen, which was written some ten weeks later, and which is an example of the effect of inco-ordination of the hand muscles.

The case is interesting as emphasizing the insidious nature of rheumatic infections, for attention was drawn to the boy's condition only by the teacher seeking advice as to the cause of the alteration in his writing.

Since rheumatism (including chorea) in children so frequently affects the heart, often producing injury which may result in early death or life-long invalidity, it must clearly be regarded as a serious condition.

Few facts in recent medical statistics are more striking than the relative and absolute increase in the number of deaths ascribed to diseases of the heart. In the Registrar General's returns, the principal cause of death is given as "Diseases of the Heart and Circulatory System," and a large proportion of these deaths were undoubtedly the result of rheumatism.

Serious as are these mortality figures, there is also to be taken into consideration the often prolonged disablement and the great amount of domestic distress which is caused by heart disease, particularly when the father or mother of a family is the one affected.

Although no method of preventing rheumatism has yet been discovered, the serious crippling heart disease arising from it in childhood can be prevented in many cases.

When affected by rheumatism or chorea, the heart, under favourable conditions, often slowly recovers more or less completely, but there is considerable danger in allowing the child to resume normal activities before the heart has quite recovered.

There is always the risk after apparent recovery from an attack of acute rheumatism that the disease may, for some time after, be insidiously affecting the heart without showing any symptoms until permanent damage has resulted. If heart complications are to be prevented, it is necessary for a considerable period after an acute attack is over, that the child should be kept under regular medical observation and live under the best hygienic conditions. Several Local Authorities have established supervisory centres for keeping under observation children who have been affected with rheumatism.

For example, in the Royal Borough of Kensington, where rheumatism in children under 16 has been a notifiable disease since 1930, all the cases under the rheumatic scheme are kept under regular supervision at the clinic. The reports of this clinic emphasize the valuable work of the voluntary social workers, by whose patience and perseverance regular attendance of the cases at the clinic are secured.

When once a child's heart has been affected as the result of rheumatic infection, regular medical supervision and constant domestic care and attention to environmental factors are necessary for a considerable period after apparent recovery. Attention should be paid to such details of personal hygiene as cleanliness, oral hygiene, well-balanced diet, suitable clothing, the proper amount of rest and sleep, regulated scholastic work, physical exercises and play. In the majority of cases it is quite impossible to have these requirements fully complied with while the children are living at home.

It is for such cases that residential schools of recovery for rheumatic children are beneficial, and two or three such schools have been established throughout the country.

One of the first to be established, and perhaps the best known, is the Baskerville School, near Birmingham. The cases admitted are those which have sufficiently recovered from a recent acute rheumatic infection, with or without heart involvement, to permit them being up and about for a few hours daily, but whose homes are not suited for satisfactory convalescence. At such a school all necessary rest is assured and education resumed under constant medical supervision, so that any undue strain is obviated.

After two or three terms' residence under ideal conditions the powers of resistance become increased, the likelihood of an insidious heart disease developing becomes minimised, and the children can with more safety be allowed to return to their ordinary schools.

At such residential schools of recovery, ample isolation accommodation should be provided, because when rheumatic children are congregated together, as a result of outbreaks of sore throats, which are prone to occur, there is always the danger of fresh rheumatic infection.

CHAPTER 13

THE EYE AND ITS DEFECTS

Structure and physiology of the eye. Defects of vision and their signs, symptoms and treatment. Hypermetropia. Myopia. Astigmatism. Squint. Methods of vision testing. Care of spectacles. Eye diseases. Colour blindness. Blind and partially sighted children, their classification and education.

PHYSIOLOGY OF THE EYE

THE eye is set in a deep bony cavity of the skull, called the orbit, the space between the eyeball and the bone being occupied by a cushion of fatty tissue. The front of the eye is protected by the upper and lower eyelids, from the margins of which project long curved eyelashes, which help to prevent particles of dust and other foreign bodies from getting on to the eyeball. The inner surface of the eyelids and the whole of the front of the eyeball, with the exception of the clear part in the centre, is covered with a thin, very sensitive membrane known as the *conjunctiva*, which is kept lubricated by the tears secreted by the lachrymal glands, situated at the upper and outer part of the orbital cavity.

The eyeball has three distinct coats, a thick, fibrous, outer coat called the *sclerotic*, which is continuous with the transparent portion in front known as the *cornea*. Inside the sclerotic is a very vascular layer known as the *horocid*, whilst the innermost layer, the *retina*, is the part of the eye sensitive to the light. It contains certain specialized nerve endings, called by physiologists rods and cones, because of their shape, and also contains a special fluid called the visual purple.

The rods and cones are specially abundant at a spot called the macula or fovea centralis, which is situated in the centre of the retina and is the part of the retina which is mainly used in vision, being particularly sensitive to light impressions.

The interior of the eyeball is divided by the *crystalline lens*, into two compartments, a small anterior chamber filled with a clear watery fluid (*aqueous humour*) and a larger posterior chamber filled with a transparent jelly-like substance (*vitreous humour*). The lens, which is elastic and biconvex in shape, is maintained in position by means of a ring-shaped ligament running from its circumference to the ciliary body, which is situated at the front end of the choroid and contains the ciliary muscle.

Immediately in front of the lens is a coloured, circular body termed the *iris*, in the centre of which is an opening, known as the pupil, which, by the contraction of certain muscular fibres contained in the iris, can be made by reflex action as occasion requires, larger or smaller in order to regulate the amount of light entering the eye.

Edridge Green's theory of the mechanism of vision is that the cones are the true nerve endings of the optic nerve, and are bathed by the visual purple, the function of the rods being to control the amount of secretion of the visual purple according to requirements.

When rays of light reach the retina they decompose the visual purple, thus stimulating the cones and causing impulses to be conveyed along the optic nerve to the visual centre in the brain, where the sensations are interpreted according to the wave-lengths of the particular rays of light coming from the objects looked at.

For the proper understanding of the principles concerned in vision some knowledge of the science of optics is necessary.

Rays of light passing from one distant object to another may be regarded, for all practical purposes, as travelling in

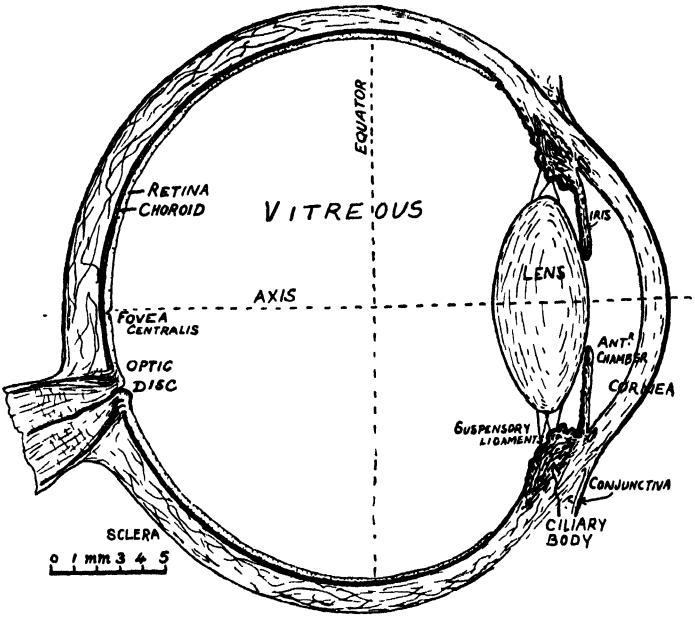


FIG. 34. *Horizontal section through the Eye.*

(*From Kerr's "Fundamentals of School Health," by permission of Messrs. George Allen & Unwin, Ltd.*)

straight parallel lines so long as they are passing through one medium, such as air. When, however, these rays enter a different medium, such as glass or water, the direction of the rays may be altered. In the case of parallel rays of light being made to pass through a convex lens, they are converged so as to meet at a point behind the lens, known as its *focus*. This can be demonstrated by focussing the sun's rays through a magnifying glass on to a piece of paper, which will become brilliantly illuminated at a particular point, and the heat rays of the sun, which are also brought to a focus in the same manner, may scorch the paper or even set it on fire. The more convex the lens the greater the convergence of the rays, and the shorter the distance between the lens and its focus.

Convex lenses have a similar bending effect on rays of light which are not parallel, but which are either converging or diverging, in the former case increasing the extent of the convergence, and in the latter diminishing it.

On the other hand, when parallel rays of light are made to pass through a lens which is concave, the rays are caused to diverge, the amount of the divergence depending upon the degree of the concavity of the lens.

In the case of a normal eye, parallel rays of light coming from an object at least 20 feet away, after travelling through the cornea, aqueous humour, lens and vitreous humour, all of which acting together produce the effect of a strong convex lens, are refracted, that is, bent so as to come to an exact focus on the retina at the macula. Such an optically perfect eye is known as an *Emmetropic eye.*

When objects are less than 20 feet away the light rays coming from them are not parallel but somewhat divergent, and were it not for a certain power which the eye possesses, known as *accommodation,* these rays could not be focussed accurately on the macula and the object seen would appear blurred. Accommodation is effected by the ciliary muscle contracting and so relaxing the tension on the suspensory ligament of the lens, and since the lens possesses a considerable amount of elasticity, it bulges forward and becomes more convex, thus increasing its power of converging the rays of light.

By means of this power of accommodation, near work, such as reading, writing and sewing, is possible without the aid of glasses.

During childhood the extent of accommodation possible is very considerable, but from adolescence onwards it steadily diminishes, and at about the age of 45 it has become so limited that reading without the aid of glasses becomes difficult or uncomfortable. This natural failure of the power of accommodation is called *Presbyopia,* and in this condition, in order to obtain clear vision for near work the use of convex lenses becomes necessary.

DEFECTS OF VISION

THERE are three main defects which may occur in the refractive power of the eye, and which interfere with perfect vision, by preventing the object from being accurately focussed on the retina. These are known as Hypermetropia (long sight), Myopia (short sight), and Astigmatism.

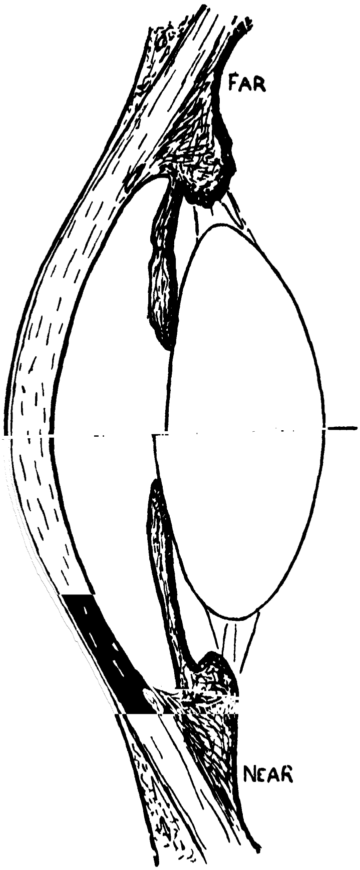


FIG. 35. *Diagrammatic representation of the change in the shape of the Lens of the Eye during accommodation.*

(From Kerr's "Fundamentals of School Health," by permission of Messrs. George Allen & Unwin, Ltd.)

HYPERMETROPIA is the commonest visual defect in school children, and is caused by the eyeball being too short from front to back, with the result that, when the eye is at rest and focussed for distance, the rays have not yet come to a focus when they reach the macula, as the focussing point of the lens is behind the retina, consequently the object looked at is not quite clearly seen. In the young, however, this defect can be considerably overcome by means of the power of accommodation, but in many cases of hypermetropia the constant strain on the ciliary muscle occasioned by accommodation not only causes eye-strain with resultant headaches, but is apt to induce a squint. The defect can be remedied by the wearing of suitable convex lenses, which, by further converging the rays of light bring them to a focus on the retina.

MYOPIA is a condition in which the eye is too long from front to back, so that the lens brings all distant objects to a focus in front of the retina, with consequent blurring of the vision.

All degrees of myopia are met with, varying from cases of slight degree up to those with a high degree of the defect. In cases of high myopia degenerative changes may occur at the back of the eye, such as stretching and thinning of the retina, whilst sometimes even a part of the retina may become detached, with resulting blindness. Accommodation can be of no assistance at all in overcoming this defect, in fact it would only make matters worse. The treatment of myopia is the provision of suitable concave lenses, which cause the rays of light to diverge slightly before passing through the eyes, thereby bringing the object to a sharp focus on the retinæ. A myopic person usually holds reading matter close to the eyes, and can then see quite well even very fine print, but at a distance difficulty is experienced in distinguishing objects clearly.

ASTIGMATISM. In the normal eye the front surfaces of the cornea and lens are curved equally in every direction, like a watch glass, but in some eyes the curvature in one axis is different from that in the opposite direction. This condition is spoken of as astigmatism. The result of this unequal curvature of the cornea or lens is that while rays of light passing through one axis of the cornea may be clearly focussed on the retina, those passing through the cornea at right angles to this axis will not be focussed on the retina, and the object looked at will therefore appear somewhat blurred.

Persons affected with astigmatism cannot see all the figures on a clock with equal clearness, those in one axis, as for example XII and VI, may appear darker and clearer than the numbers III and IX in the opposite axis. A simple test for the presence of astigmatism is carried out by the use of a chart, on which lines of equal blackness are drawn radially in the shape of a fan ; if any astigmatism be present one or two adjacent lines will look blacker than the remainder.

Astigmatism is often associated with hypermetropia or myopia, but more commonly with the former.

The eyes of very young children are usually hypermetropic, but during growth the eyeball gradually increases in length, and in this manner a hypermetropic eye not only becomes less hypermetropic, but may even pass through the stage of emmetropia to that of myopia.

Similarly, in the case of young children whose eyes are emmetropic, the tendency during growth will be for the eyes to become myopic, and young children with myopic eyes will, as they grow older, become more myopic.

In the case of children with myopia there is sometimes difficulty in convincing the parents of the desirability of correcting the defect with glasses, as, unless the defect is very marked, the children may experience very little difficulty in doing near work, and distant vision, though poor, causes them no discomfort. The correction of the defect as soon as possible is important, since, with growth, the condition tends to be progressive, and eye-strain aggravates it, and when high degrees of myopia develop it is often accompanied by serious degenerative changes in the retina.

The action of spectacles in correcting defects of vision due to hypermetropia and myopia, can be understood by reference to the accompanying diagrams. Fig. 36 shows the relative positions of the retina in the case of a hypermetropic eye (H), an emmetropic eye (E), and a myopic eye (M), parallel rays of light passing through the lens of the eye being brought to a focus at the point F, which in the case of the normal or emmetropic eye coincides with the macula on the retina. In the case, however, of the hypermetropic eye, which is shorter than the normal eye, the focussing point of the lens falls behind the retina, whereas in the case of the myopic

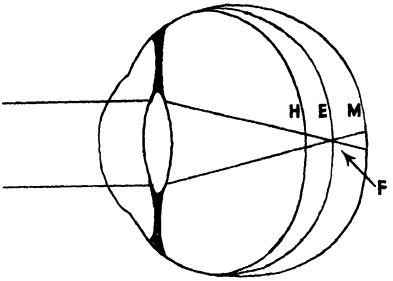
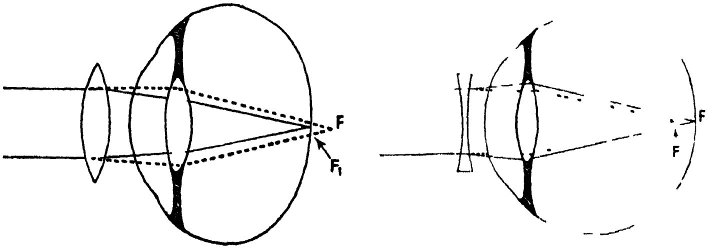


FIG. 36. *Diagrammatic representation of the shape of an Emmetropic, a Hypermetropic, and a Myopic Eye.*

eye, which is longer than the normal eye, the focussing point is in front of the retina. Therefore, in both hypermetropia and myopia the image of the object looked at will appear blurred because it is not accurately focussed on the retina.

In hypermetropic eyes this disadvantage can to a large extent be overcome by using the power of accommodation, whereby the convexity of the lens is increased and the distance between the lens and its focus is shortened.



FIGS. 37A and 37B. *Diagrams illustrating the function of lenses in correcting Hypermetropia and Myopia.*

Fig. 37A illustrates a hypermetropic eye, in front of which a convex lens has been placed in order to cause the parallel rays of light to converge before entering the eye sufficiently to enable them to be brought by the lens of the eye to an exact focus on the macula at F_1, without the aid of accommodation.

Fig. 37B illustrates a myopic eye, in front of which a concave lens has been placed in order to cause the parallel rays of light to diverge sufficiently before entering the eye, to enable them to be brought by the lens of the eye to an exact focus on the macula at F_2.

To correct astigmatism, lenses are ground with a greater curvature in one particular direction than in the opposite one, in order to counteract the unequal curvature of the cornea.

SQUINT. This is the condition in which both eyes do not look exactly in the same direction. The movements of each eye are controlled by six muscles, and the muscles of both eyes must act in perfect co-ordination in order that the object looked at shall be focussed on the macula of each eye ; failure to do this would result in double vision and a squint.

Binocular vision is the result of the fusing in the visual centre of the brain of the very slightly different images received from each eye, the visual centre interpreting them as one stereoscopic image. This power is not present in the new born child and has to be learnt. If, therefore, there should be some refractive error in one of the eyes, whereby markedly different images are being dealt with by the visual centre, some visual confusion may arise, and a squint ensue.

A squint is nearly always due to some error of refraction, such as hypermetropia or myopia. When such defects are present, a relatively small incident, such as a fall, a fright, or an attack of measles or whooping cough, may be the culminating factor in determining the onset of the squint. The most common form of squint is that in which one eye turns inwards or converges, and this variety is often associated with hypermetropia. Less common are external or divergent squints, which occur sometimes in cases of myopia.

A squint most often commences during pre-school life, and it is important that it should be treated immediately it arises, because the sight in a squinting eye rapidly deteriorates, and may become permanently impaired. It is a great mistake for parents to postpone obtaining treatment for squint until the children are of school age, as by this time treatment can seldom be of any value.

In the examination of children's eyes for the purpose of prescribing glasses, specialists in eye work usually find it necessary to use atropine drops or ointment, for the purpose of temporarily putting out of action the power of accommodation, as otherwise the total error of refraction is difficult to ascertain correctly. There is a certain amount of prejudice on the part of some parents against the use of atropine, as they imagine that the eyes may be injured thereby, though actually there is not the slightest risk from its use. As it takes several days for the effects to wear off and for accommodation to be re-established, near work, such as reading and writing, should not be attempted during this time.

The signs and symptoms suggestive of defective eyesight include: bending the head unusually close when reading, writing or sewing; frowning or screwing up the eyes when looking at objects; tilting of the head as in certain cases of astigmatism; the presence of a squint; headache, irritation or watering of the eyes, and difficulty in seeing clearly near or distant objects. Poor writing and mistakes in reading may sometimes be attributable to bad eyesight. In cases of suspected defective vision, the sight is tested both for near and distant vision by means of standardized test-types, near vision is tested by Jaeger's types, in which reading matter is printed in a number of sizes graduated from very small to very large, the smallest of which should be read by a normal eye at a distance of 10 inches.

The testing of distant vision is done by getting the child to read from a distance of 6 metres (20 feet) lines of letters of graded sizes known as Snellen's test-types. Each line of letters has a number assigned to it, the number representing the distance in metres at which a normal eye should be able to read the letters of that line. The largest letter of the test-types can be read by the normal eye at a distance of

60 metres, the succeeding lines at 36, 24, 18, 12, 9, and 6 metres respectively. The test-types must be well illuminated by natural or artificial light. Each eye is tested separately, and the eye not being tested is covered with a card.

The distant vision is recorded as a fraction, the numerator being the figure 6 when the child is tested at the standard distance of 6 metres, whilst the denominator is the lowest line read by the eye tested. For example, if the vision of the right eye is recorded as $\frac{6}{6}$ and that of the left $\frac{6}{18}$, this means that the distant vision of the right eye is normal while that of the left eye is defective, as it is only able to see at a distance of 6 metres the line which a normal eye is capable of reading at 18 metres. As the routine testing of the vision of school children by the school medical officers is carried out only at the ages of 8 and 12, it will be realized that a number of cases of defective sight arising between these ages are liable to be overlooked, to the detriment of their sight and their progress in education. In order to obviate this, arrangements exist in Liverpool, whereby once each year the head teachers examine with Snellen's test-types the sight of all children aged 9, 10, 11, and record the results in an eye register, which the school medical officer consults when he next visits the school.

When glasses have been obtained, it sometimes takes a little time for the eyes to get accustomed to their use.

The lenses should be worn as near as possible to the eyes, and the side pieces should extend from their hinges in a perfectly straight and horizontal line to the tops of the ears.

In removing spectacles both hands should be used, and care taken not to strain the hinges. Spectacles should be laid down on their side, so as to avoid the lenses being scratched. The glasses should be kept scrupulously clean, but in cleaning them care must be taken that only soft material is used, avoiding the use of such materials as silk or tissue paper, which may scratch the lenses. Children often bend the frames in the process of cleaning, and in order to obviate this, the spectacles should be held by that part of the frame enclosing the particular lens which is being cleaned.

When a spectacle lens comes out of its frame, the spectacles, along with the prescription, should be taken to an optician for the replacement of the lens, since it may be wrongly replaced if done by an unskilled person.

DISEASES OF THE EYE

CONJUNCTIVITIS, which is an inflammation of the conjunctiva, is a fairly common, though seldom a serious eye affection. It is characterized by the eye becoming red and blood-shot as a result of congestion of the conjunctiva. A thin watery discharge is present in the early stages, but later, this may become muco-purulent in nature, and the eyelids tend to stick together after a night's sleep. The eyes are sore, and feel as though some grit had got into them, whilst in the more severe cases the eyes are intolerant to light. Conjunctivitis is a typical symptom of the early stages of measles, and sometimes accompanies a common cold.

Most cases of this condition are due to infection of the conjunctiva by bacteria, and this explains why from time to time outbreaks occur in schools, the infection being spread by means of towels, etc.

TRACHOMA is a chronic and severe form of conjunctivitis, which is common in the East and in some European countries, but fortunately rare in this country. It is characterized by the appearance of small, pale nodules, mostly on the under surfaces of the lids. In the later stages of the disease the cornea also becomes involved, causing serious interference with vision. As the disease is contagious, any child suffering from this condition must be excluded from attendance at school.

CORNEAL ULCERS may occur in ill-nourished children, often as a complication of certain forms of conjunctivitis. They are both painful and serious, since in the process of healing scars are usually left on the cornea, and these interfere considerably with vision.

KERATITIS is an inflammation of the cornea, sometimes associated with certain varieties of conjunctivitis, one serious variety, due to congenital syphilis, being known as interstitial keratitis. This latter form usually commences about the middle of school life, and may so interfere with vision as to necessitate the child's education at a class for partially sighted children, or even in a school for the blind.

BLEPHARITIS is one of the commonest external eye diseases among children. It is largely a disease of pre-school age, the majority of the cases commencing at about the age of four. It is more common amongst the children in the poorer neighbourhoods, and it is possibly due to some vitamin deficiency, the administration of cod liver oil being useful in assisting recovery.

The acute form of the condition is often due to an extension of an inflammation of the skin of the eyelids, or of conjunctivitis, and is a common sequel to an attack of measles. In the early stages there are noticed little dry scales fixed to the eyelashes, and the lid margin may be slightly reddened. As the disease progresses the crusting increases, the eyelashes are lost, the Meibomian glands are destroyed, and the edges of the lids are always wet, red and sore looking. As blepharitis requires prolonged, regular, and skilled treatment, the cases not under private medical treatment should be sent regularly to the minor ailments clinic.

In some of these cases there may be some defect of sight, and failure to correct this may considerably impede recovery.

STYES are pustules caused by infection of one of the sebaceous glands connected with the eyelashes, and may cause considerable swelling of the eyelid. Sometimes a series of such styes occur in debilitated children.

CATARACT is an opaque condition of the lens, causing serious interference with vision. It is not common amongst children, though occasionally it is congenital, and sometimes it may result from a penetrating wound of the eye, or from a severe blow on the eye. The condition is more common amongst elderly people, when it is known as senile cataract. In well-marked cases the cataract is plainly visible as a ground-glass-like object behind the pupil. The only treatment for these cases is by means of an operation.

COLOUR BLINDNESS

THOUGH complete colour blindness is very uncommon, partial colour blindness is not so rare, and occurs much more frequently amongst males than females, some 5 per cent. of men being probably dangerously affected. It is probably due to a defect of certain of the colour perceiving cones of the retina. It may be hereditary, or acquired through disease, or caused by excessive tobacco smoking in the case of adults.

The colours which are most commonly confused are red, and its complementary colour, green. Since these are the colours used for night signals on the railways and at sea, and on the roads as robot traffic signals, it is important that those who have to interpret such signals should not be colour blind.

Since the existence of this defect would in certain cases affect the choice of a career, the colour vision of school children, particularly boys, should be tested once during their school life.

Formerly the method of testing was to require the person to match coloured skeins of wool, slips of coloured glass or beads, but this method is now considered unreliable. For accurate testing, a lantern devised by Edridge Green is used, because it gives a close imitation of signal lights seen at different distances, under varying atmospheric conditions, such as rain and fog.

BLIND AND PARTIALLY SIGHTED CHILDREN

In the Education Act, 1921, a " blind " child is defined as one who is " too blind to be able to read the ordinary school books used by children," and the Act imposes the duty on a parent of a blind child to see that he or she receives suitable instruction, and also on local education authorities to make efficient and suitable educational provision for such children.

From the educational point of view there are three grades of blind and partially sighted children, namely :—

(*a*) Those who have no perception of light, or whose vision is so defective that they cannot be taught by visual methods.

(*b*) Those whose vision is so defective that they cannot be properly taught in the ordinary elementary schools, but can see well enough to be taught by special visual methods.

(*c*) Those suffering from such conditions as high or progressive myopia, who, though they can read the ordinary school books used by children, should not be permitted to do so, since thereby the eye defect might be aggravated.

Blind Children, that is, the children comprising group (*a*), require to be educated by blind school methods. The *causes of blindness* of the children in this group are :—

(1) Ophthalmia Neonatorum, which is a gonorrhœal infection of the eyes at birth, resulting in an opaque condition of the cornea. Formerly about a quarter of the cases of blindness were due to this cause, but since this disease was made notifiable by Public Health Regulations issued in 1926 and 1928, its prevalence has been very greatly diminished. These Regulations also gave local health authorities power to provide expert treatment for the condition.

(2) Congenital syphilis, which is responsible for most of the cases arising during school life, the blindness resulting from damage done to the cornea or the retina.

(3) Accidental causes of blindness due to damage to the eyes by foreign bodies, or infection through the conjunctiva.

(4) Congenital defects, such as cataract and hereditary eye diseases.

For the ***education of blind children*** there are throughout the country some 50 schools recognized by the Board of Education, more than half of these being residential schools. The training of the blind depends upon the specialized development of the senses of touch and hearing. For reading purposes the children use Braille, which is felt by the finger-tips. This type consists of combinations of raised dots, there being a separate arrangement of these dots for each letter of the alphabet. Modifications of the Braille method are used for teaching other subjects. Owing to the fact that blind children are naturally timid, and not self-reliant, outdoor games are particularly useful in overcoming these characteristics, and much ingenuity has been brought to bear in devising means whereby the children can participate in games similar to those played by normal children.

The education of blind children is compulsory between the ages of 5 and 16, and under the Blind Persons Act, 1920, it is also the duty of education authorities to make provision for the technical education of blind persons who are capable of benefiting from such education, such vocational training includes cane chair-making, basket work, the making of brushes and mats, and piano-tuning.

Under the Old Age Pensions Act blind persons are entitled to pensions at the age of 40.

PARTIALLY SIGHTED CHILDREN, that is, children who can see well enough to be taught by special visual methods, *i.e.* those coming within categories (*b*) and (*c*), will probably never become certifiable under the Blind Persons Act, and so will not become eligible for the benefits under this Act, but will always have to compete with the sighted community in earning a livelihood. In 1931 the Board of Education appointed a Special Committee to inquire and report upon the medical, educational and social aspects of the problems affecting partially blind children.

FIG. 38. *Blind children learning from Braille Type.*

(By permission of H. Wills, Esq., F.R.P.S.)

This Committee expressed the opinion that the term "partially blind," hitherto used for such cases, is a misnomer, and suggested that for the future such children should be referred to as "partially sighted children."

Generally speaking, any child whose vision with both eyes after correction with spectacles is $\frac{6}{24}$, or worse, should be regarded as a "partially sighted child," and receive special education. It was estimated that there are at least 1 per 1,000 of the school population who should be given such special education.

It has been found that about half of these cases are attributable to myopia of more or less severe degree, whilst the remainder are chiefly due to various congenital or hereditary defects or to diseases of the cornea or inner coats of the eye. There is always a tendency for the myopia cases to get worse, but as a rule the vision of the other cases remains more or less stationary.

In the past the authorities who have provided special education for partially sighted children have done so in one of three different ways. The great majority have provided special schools, some have arranged for their special education at schools for the blind, whilst others have established special classes in the ordinary elementary schools. The Committee expressed themselves in favour of the last method, and suggested that in isolated areas where the establishment of such classes is not practicable, the affected children should be sent to residential schools, or boarded out in the neighbourhood of special classes.

One of the advantages of holding these special classes on the premises of a public elementary school is that the children can join the ordinary classes of the school for such lessons as singing, geography and history, and subject to any restrictions imposed by the oculist, who keeps the children under regular supervision, they can share in the recreation and general corporate life of the school. These classes should, of course, be much smaller

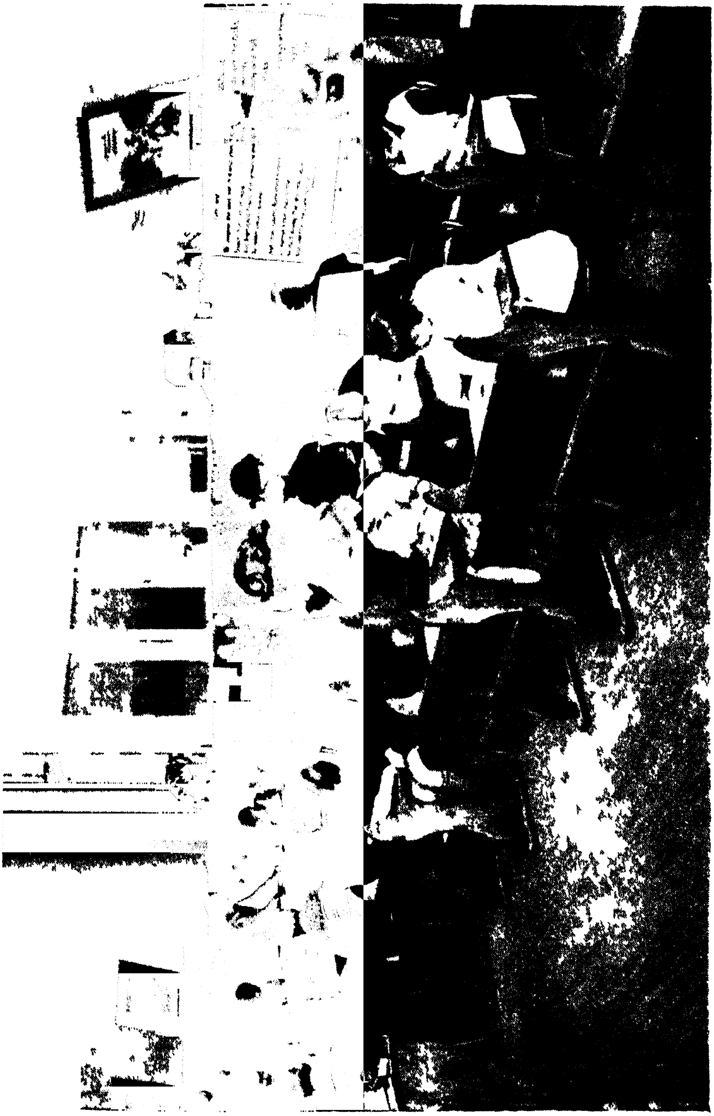


FIG 39. *Education of partially sighted children.* (Note the Bishop Harman desks and wall boards)

than the ordinary classes, in order to permit of more individual tuition.

The ordinary curriculum of the elementary school is followed as far as possible, but the teaching methods and the equipment are modified to meet the particular needs of the children. Some of the special equipment used includes the Bishop Harman combined desk and blackboard, the top of the desk being reversible, and having on its under surface a blackboard on which the child can write with chalk in large letters. A band of blackboard is also fitted round the walls for the children to write upon, which they are required to do at arm's length. Use is also made of large-type printing sets. With regard to books, some of the infant-type readers are suitable, but for the older children there are now obtainable certain books specially printed in large type. For the older children, typing by touch may be permitted. Selected pupils are allowed to do handwork, such as wood and metal work, girls are also permitted to attend the cookery and laundry centres. Other subjects taught are rug making, raffia work, clay modelling, simple leather work and flower-basket making, and knitting with pins by the sense of touch and not of sight.

As the children often have to come some distance to these special classes, the authorities can provide conveyances or guides to take the children to and from school. Though the main purpose of these classes is to save sight and provide the most suitable type of education, another object is the development of self-reliance and self-confidence in the children.

The children may remain in these classes until they are 16. In Liverpool, during their last term a conference is held between the parents, head teacher and oculist, to decide on the most suitable employment, and a special officer from the juvenile employment bureau is also present, who subsequently endeavours to find posts in the employments decided upon. In London, a Voluntary After-Care Association undertakes the supervision of any cases referred to them on leaving school.

CHAPTER 14

THE EAR AND ITS DEFECTS

Structure and physiology of the ear. Otorrhoea. Deafness, causes and classification. Methods of testing hearing. Education of the deaf.

PHYSIOLOGY OF THE EAR

THE organ of hearing consists of three main parts which are known as the external, middle, and inner ear. The *external* ear in animals is a kind of mobile ear trumpet which can be turned in the direction from which sound is coming, but in man it is of less practical use, as the power of movement has been lost.

A canal leads from the external ear to the drum, and is provided with hairs and wax-secreting cells, the wax and hairs probably serving the purpose of trapping small insects which may gain entry.

The *middle ear* is located in a bony cavity situated between the outer and inner ear, from the former of which it is separated by the drum, and from the latter by two delicate membranes, known as the fenestra ovalis and the fenestra rotunda. A chain of three bones runs through the middle ear, from the drum to the fenestra ovalis, their object being to pass on the sound vibrations received on the drum and concentrate their force on the much smaller fenestra ovalis.

These bones are known as the malleus, incus, and stapes, which are the Latin terms respectively for a hammer, anvil, and stirrup, which the bones resemble in shape. From the middle ear there is a small channel known as the Eustachian tube, which leads to the back of the nasopharynx, and serves the purpose of equalizing the air pressure on both sides of the drum.

The *inner ear* is contained in a hollow cavity within the temporal bone, and consists of three main parts, known as the cochlea, utricle with the semi-circular canals, and the saccule.

The *cochlea* is a hollow chamber, shaped like a snail-shell, coiled into a spiral of 2¾ turns and divided into three compartments, each containing fluid. At the larger end of the coil are two membranous windows, the fenestra ovalis, to which the end of the stapes is attached, and the fenestra rotunda. Within the spirals of the cochlea is the organ of Corti, which consists of thousands of stretched fibres running cross-wise, all being of different lengths, suggestive of the strings of a piano. These fibres act as resonators, each of which is capable of responding to a particular note, the treble resonators being at the apex of the cochlea, and the bass resonators at the other end. On these fibres are special hair-cells which are connected with the auditory nerve.

The following processes are involved in hearing. When sound waves impinge on the drum of the ear, it is made to vibrate, and as the handle of the malleus is attached to the inner side of the drum, this also is set vibrating, the vibrations being passed on through the incus to the stapes. The other end of the stapes is connected to the membrane covering the fenestra ovalis in the cochlea, and this is set vibrating, a wave-like motion being set up in the fluid in the cochlea. This wave passes up one of the compartments to the apex of the cochlea and down another, at the end of which is a membrane covering the fenestra rotunda, this membrane acting as a sort of shock absorber. The oscillations of the fluid in the cochlea stimulate the hair cells, and through these the terminal fibres of the auditory nerve, which is connected with the auditory centre in the brain, where the impulses received are interpreted as sound.

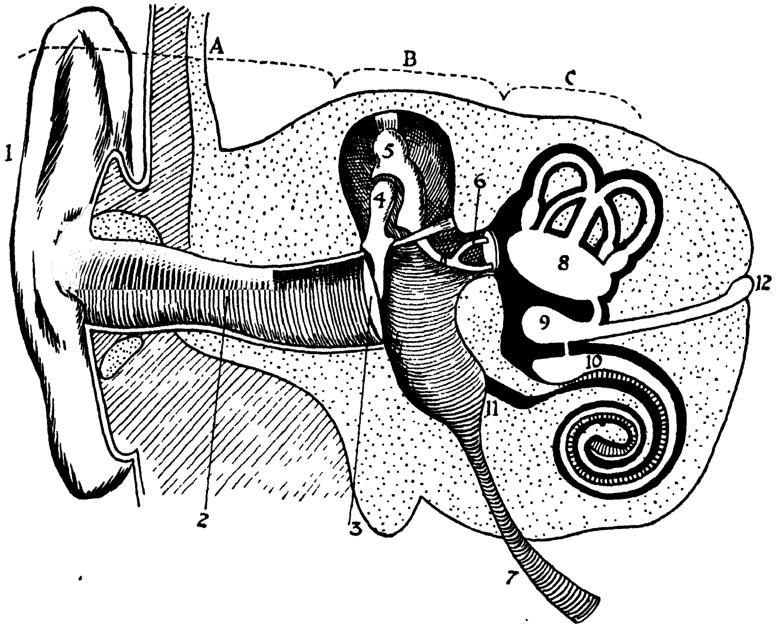


FIG. 40. *Diagram of the Ear.* A. The outer ear. B. The middle ear. C. The inner ear. 1. The external ear. 2. The external auditory canal ending at (3) the drum. 4, 5, 6. The malleus, incus, and stapes which ends at the fenestra ovalis. 7. The Eustachian tube. 8. The utricle with the three semi-circular canals. 9. The saccule. 10. The cochlea. 11. The fenestra rotunda.

(From "The Outline of Science," by permission of Messrs. George Newnes, Ltd.)

The *Utricle* is a sac-like swelling lying between the cochlea and semi-circular canals. On its walls there are two sets of sensitive nerve cells, one in the vertical, the other in the horizontal plane. In amongst the hair-like processes of these nerve cells are some small nodules composed of lime, and called Otoliths. When the head moves in different directions these otoliths are caused to press on the hairs of the nerve cells, and by their stimulation, the brain is kept informed as to the particular inclination of the head.

The *semi-circular canals* are three in number, and they are each arranged in the form of a half circle, one end leading out of the vestibule, and the other end leading into the vestibule.

The three semi-circular canals are arranged in three different planes at right angles to each other. These canals, which are filled with a fluid called endolymph, have certain hair cells for the purpose of informing the brain of the position of the head. When the head is moved, say from right to left, the endolymph in the horizontal canal lags behind, and causes a movement of the hairs in its nerve cells, whereby a message is sent to the nerve centre in the Cerebellum, creating a sensation of horizontal movement. Similarly the other semi-circular canals interpret movements in the other planes.

The *saccule* is another small membranous sac, connected with, and lying between, the utricle and the cochlea. It also contains otoliths suspended in the fluid within it, and it is concerned with the body equilibrium.

OTORRHOEA

THIS condition, as its name means, is characterized by a discharge from the ear. In nearly all cases it is due to a purulent inflammation of the middle ear, resulting in the formation of an abscess, which perforates the drum and discharges through the external auditory meatus. Though the majority of the cases commence during school life, between 1 and 2 per cent. of school children being found with this condition, a number of cases also commence during pre-school life. Otitis media, or middle ear disease, is almost always caused by infection spreading from the nasopharynx up the Eustachian tube, usually as the result of an attack of scarlet fever, measles, or in connection with catarrhal conditions of the nasopharynx, such as colds, influenza, or an unhealthy condition of the adenoids.

A discharging ear should receive immediate treatment, since, if it becomes chronic, it not only may cause destruction

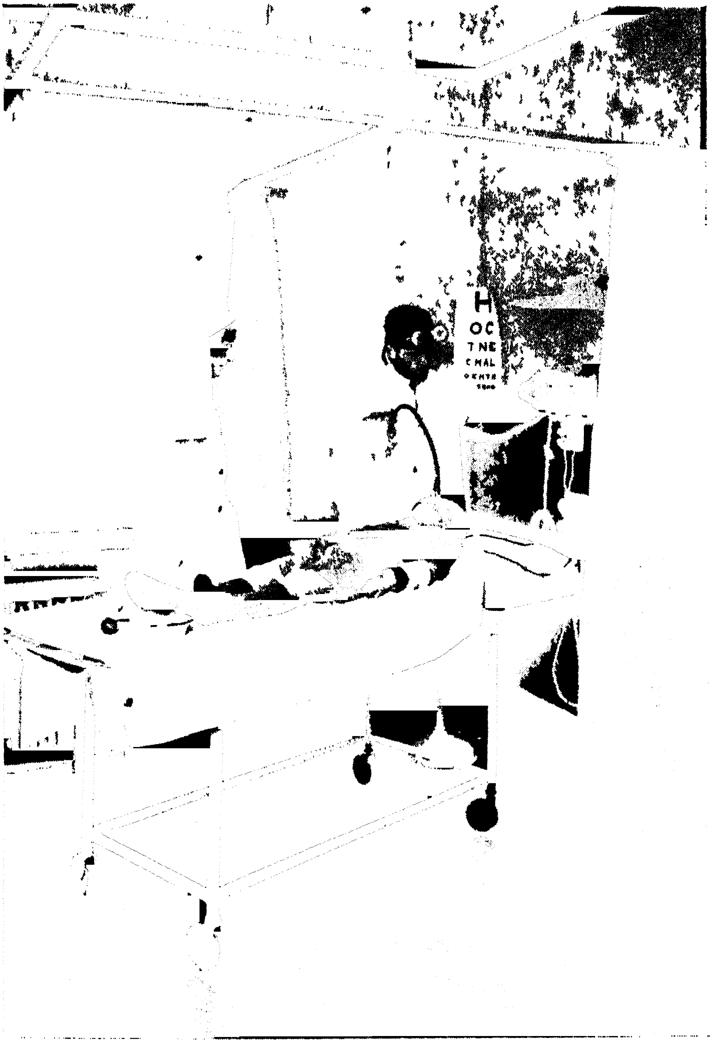


FIG. 41. *Treatment of Otorrhoea by Zinc Ionisation.*
(Photo kindly supplied by the Medical Officer of Health, Birkenhead)

of the bones of the middle ear, with resultant deafness, but the inflammation may extend to the mastoid air cells in the temporal bone behind the ear, and cause a mastoid abscess, which is a serious condition, requiring immediate operation. Other complications which may arise are meningitis or a brain abscess, either of which is almost always fatal.

The treatment of otorrhœa in its early stages is usually by antiseptic methods, and by this means many of the cases are cured. There are, however, many cases amongst school children in which the condition has become chronic, and such cases are usually extremely difficult to cure by the ordinary antiseptic methods, owing to the fact that the bacteria have penetrated deeply into the tissues and are thus not reached by lotions or drops.

The method of treatment known as " zinc ionization " overcomes this difficulty. In this method the infected ear is filled with a solution of zinc salt, through which a very weak electric current is passed. By this means zinc " ions " are liberated and are driven into the affected tissues, in consequence of which the albumin of the tissues and that of the infecting bacteria becomes coagulated, with the result that the bacteria are killed.

Except in those cases where the bone has become involved, and an operation is required for the cure, this method is nearly always successful. Sometimes only one application of the ionization is required, even in cases which for years have persistently resisted other methods of treatment.

DEAFNESS

DEAFNESS may vary from slight impairment of hearing up to total deafness. Dr. Eichholz, in a comprehensive report published in 1932, and entitled " A Study of the Deaf," classified deaf persons into the following four categories :

(1) The " *Deaf-Mute*," that is, those who being deaf from birth are devoid of useful hearing and speech.

(2) The " *Semi-Mute*," namely those in whom deafness

was acquired in infancy. Although these cases have no hearing, they are more easily amenable to training by speech methods than the deaf-mutes, since they once possessed the sense of hearing.

(3) The "*Speaking Deaf,*" who became deaf after having learnt to speak, and though totally deaf can the more readily be taught by speech methods.

(4) The "*Partially Deaf,*" including the "Hard of Hearing."

In the case of the deaf-mutes, the deafness is due to congenital defect of the auditory apparatus. These children cannot think in words like normal children, and such thoughts as they may develop they associate mainly with the sense of muscular movements, which they connect in their minds with ideas or objects.

Nerve defects are responsible in the main for the second and third groups. The Speaking Deaf children are usually quite deaf, and until trained, such speech as they possess is therefore recollected speech. Without such special teaching the speech of this group is apt to deteriorate, or may be entirely forgotten.

The deafness in the case of the Partially Deaf is usually caused by disease of the middle ear. These children have some hearing for vowels and consonants and also for some words, and much of what they are taught can be learnt by means of the auditory channels. Partial Deafness may vary from only a slight degree of deafness, namely, the hard of hearing cases, up to almost total deafness. Kerr Love has stated that if a child does not hear whispered speech with at least one ear at a distance of six feet, he cannot profitably remain in the ordinary classes of an elementary school. Partially deaf children, whose hearing is better than this standard, should, if left in the ordinary schools, occupy the front rows of their classes. The intermediate types of cases should be taught in special classes for the partially deaf, and those suffering from the greater degrees of partial deafness should be taught in schools for the deaf.

Statistics of the London County Council, taken over a period of ten years, showed that in approximately one-quarter of the cases the deafness was attributable to congenital causes. Of the cases of acquired deafness about 10 per cent. were attributable to diseases of the nervous system, chiefly meningitis; 28 per cent. were due to infectious diseases, *e.g.* measles, scarlet fever, whooping cough, pneumonia, and influenza; and over 60 per cent. to primary ear disease or injury.

The statistics further showed that in most of the acquired cases the deafness commenced during the first three years of life, and nearly all the remainder before the age of ten. The defect in these acquired cases may occur either in association with the mechanism of the middle ear or of the internal ear, that is, the auditory nerve and its connections. The middle ear cases are the most common, and fortunately, also the most hopeful from the point of view of treatment.

Middle ear deafness is frequently caused by infection which has spread from the nasopharynx up the Eustachian tube, and this may occur in measles, scarlet fever, and influenza, or in general septic conditions affecting the tonsils, adenoids, or pharnyx, or from inflammation connected with disease of the bones of the nose.

TESTS FOR DEAFNESS.—There are several methods by which the degree of deafness can be tested. One is by means of the *watch test*, but as in this method the response depends upon such variable factors as the loudness of the tick of the particular watch used, and the noise in the room at the time of the test, this test cannot be standardized. It is, however, useful as a rough and ready test for the hearing of each ear, the distance in inches at which the child can just hear the particular watch, being used as the numerator of a fraction, of which the denominator is the distance at which the examiner with normal hearing can just hear the same watch. Thus, $\frac{6}{18}$ means that the child can only hear at six inches distance the ticking of a watch which the examiner can hear

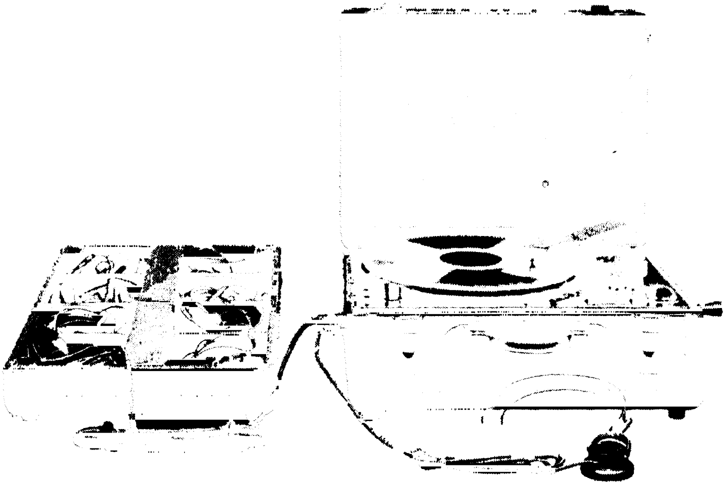


FIG. 42. *The Audiometer.*
(Photo kindly supplied by the makers, The Western Electric Company, Bush House, London, W.C. 2.)

at eighteen inches, in other words, the hearing of the ear tested is one-third of the normal.

The whisper test is the one most commonly used for school children, each ear being separately tested, first at a distance of 20 feet, the distance being gradually diminished until the whispered voice is heard. During the testing the child should stand sideways on to the examiner and cover over the distant ear whilst the other ear is being tested, the child being required to repeat certain numbers after the examiner has whispered them. It may be difficult to carry out this test satisfactorily in some schools, owing to the noise from outside.

The most accurate method of testing hearing is by means of an apparatus called the Audiometer, which can be used for testing a number of children simultaneously. The apparatus consists of a gramophone to which several sets of head-phones are connected, and specially made gramophone records are used for the test. These records are reproductions of a voice speaking slowly a series of numbers at intervals, first in a loud voice, the loudness of the voice being gradually reduced to a faint whisper, and the child or children are required to write the numbers down. As the conditions of the test with the apparatus are always the same, this test is a standardized one. Such an apparatus can be used for testing systematically all the children in the school in order to find out cases of deafness which might otherwise be overlooked.

Under the Education Act, 1921, a deaf child is defined as one who is " too deaf to be taught in a class of hearing children," and the duty is imposed upon Local Education Authorities of providing suitable education for such children, and their parents are required to see that the children receive efficient education.

The Education (Deaf Children) Act, 1937, gives power to enforce the attendance at school of deaf children from the age of five, but most authorities permit the voluntary attendance of children below this age, since most teachers of the deaf like, if possible, to commence the education of deaf children from the age of three or even two. The compulsory attendance of such children can be enforced until the age of sixteen. Since in the education of the deaf the intellectual centres of the brain have to be approached and trained mainly through the sense of sight, the first step in their education is to teach them lip-reading, or what might perhaps be better termed speech-reading. Finger-talking should be permitted only in cases which have failed to learn lip-reading, because it limits communication to those comparatively few members of the public who understand it.

Sound is caused by air vibrations of various frequencies, the most important for speech being those within the 500 to 2000 per second range, and a multitude of combinations of the various frequencies create the sounds used in speech. It has been ascertained that deafness seldom consists in

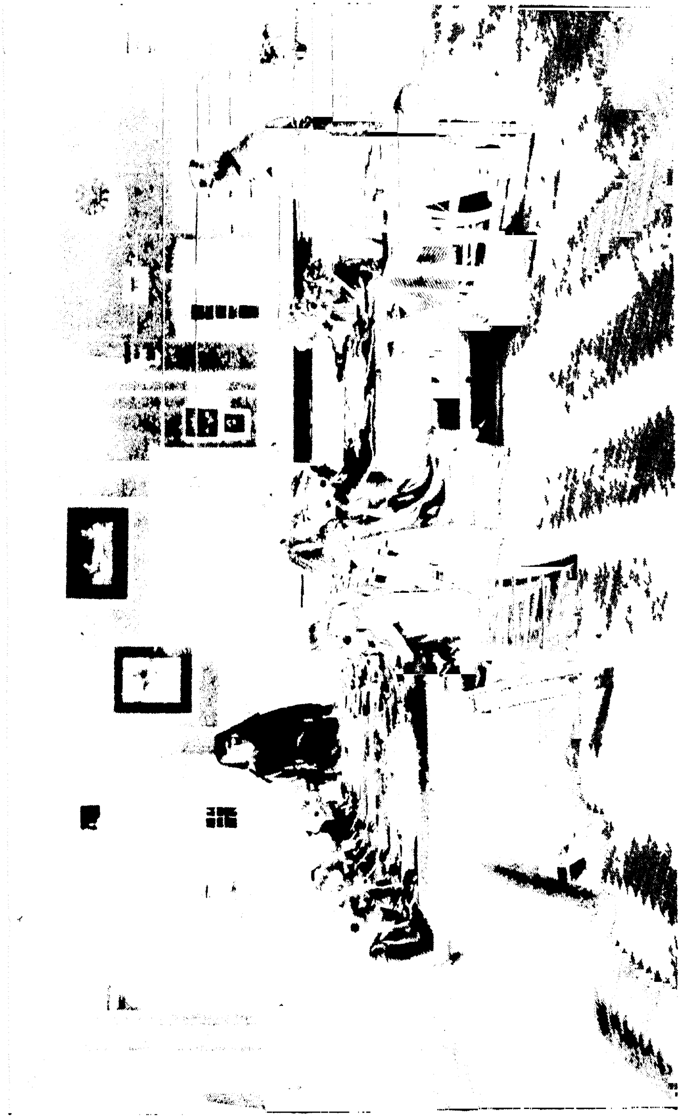


FIG. 43. *Testing Children for Deafness by means of the Audiometer.*

(*Photo kindly supplied by the makers, The Western Electric Company, Bush House, London, W.C.2*) a general all-round diminution of hearing for all the different frequencies. Thus some deaf persons may have a difficulty in hearing the high notes, and some the medium or low notes, whilst others may have difficulty in more than one range. Since it is helpful for teachers of the deaf to know in what particular frequencies any child is most defective a special Pure Tone Audiometer has been devised for the purpose of measuring the degree of hearing at octave intervals of frequencies. Such knowledge helps the teachers in understanding why deaf children find more difficulty in hearing certain sounds than others, and enables them to adjust certain forms of electrical speech amplifiers to amplify especially those frequencies to which the child concerned is most deaf.

When children are first admitted to a school for the deaf they are graded according to their age and the amount of hearing they possess. The children are first taught lip-reading and the elements of voice production, after which they are taught the usual elementary school subjects, manual work on vocational lines being emphasised. The classes should be limited to not more than 10 totally deaf, or 15 partially deaf children.

A Report entitled, " Children with Defective Hearing," was published in 1938 by an Advisory Committee which had been appointed by the Board of Education. This Committee made the following recommendations :—

1. That school children with defective hearing should be classified on the following basis :—

Grade I. Those children who do not require any special educational facilities.

Grade II. (*A*) Those children who can profitably remain in their ordinary school if they are seated in an advantageous position, or are taught lip-reading, or are provided with auricles, which are inconspicuous ear trumpets.

Grade II. (*B*) Those children who, even with such aids, cannot profitably be educated in their ordinary school, and who should therefore be educated in a special class.

Grade III. Those children who are totally deaf and should be educated in a school for the deaf, by the special methods used for deaf children.

2. That each school Medical Department should establish an aural scheme, providing specialised treatment at school clinics, and that these facilities should also be available for the treatment of pre-school children. At these clinics there should be provided a Pure Tone Audiometer for analysing the hearing of deaf children at the different frequencies, and the information thus obtained should be at the disposal of the teachers in the deaf schools.

3. That the routine testing of the hearing of all school children should be carried out by means of a gramophone audiometer.

4. That all children who have had ear complications while in fever hospitals should, after their discharge, be kept under supervision by the staffs of the School Medical or Infant Welfare Departments for the purpose of early ascertainment of any cases which might relapse.

5. That all children with running ears or nasal discharge should be prohibited from attending the swimming baths, and that those cases of otorrhœa which, on recovery, have been left with a perforation of the drum should be allowed to swim only if the ears are protected by ear plugs and by a helmet covering the ears.

6. That, for the purpose of maintaining nasal hygiene, teachers should arrange for the children to have daily nasal drill and breathing exercises.

7. That special classes should be established for teaching lip-reading to those children who would benefit therefrom.

8. That all the Grade II (A) children who would be helped thereby should be provided with individual hearing aids, such as auricles.

CHAPTER 15

DENTAL HYGIENE

Temporary and permanent teeth. Structure of teeth. Influence of diet. Causes and effects of decay. Prevention. School dentistry.

AT birth, the whole of the 20 teeth which form the temporary dentition are, in varying degrees of development, contained in bony crypts within the jaws. The front teeth are almost completely formed, but the back ones have only their crowns calcified. In addition, the early stages of the development of the 24 permanent teeth can be identified at birth.

At about the age of 7 months the temporary central incisors make their appearance, usually those of the lower jaw being cut first, whilst at the age of 9 months the 4 central incisors should be completely in place, and the 4 lateral incisors beginning to erupt. When the child is 12 months old the first of the molars should appear, followed by the canines at 18 months, and the child's full temporary dentition should be completed at the end of the second year by the eruption of the 4 second temporary molars.

Variations of a few weeks in the teething periods are not uncommon in normal children, whilst in children suffering from disturbances of metabolism, such as rickets, the eruption of the temporary teeth may be very considerably delayed.

After the completion of the temporary dentition there is an interval of about 4 years before the eruption of the first of the permanent teeth, the so-called 6-year-old molars. During this interval there is a marked development in size and an alteration in the shape of the jaws, which grow both

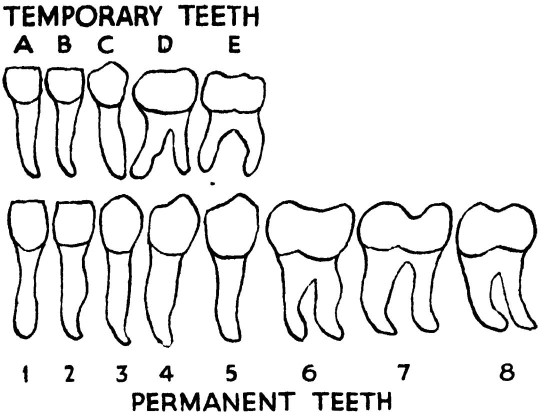


FIG. 44. *Diagram showing comparative positions in the Jaw of the Temporary and Permanent Teeth.*

Temporary Teeth—A. Central incisor. C. Canine.
B. Lateral incisor. D, E. Molars.
Permanent Teeth— 1. Central incisor. 4, 5. Bicuspids.
2. Lateral incisor. 6, 7. Molars.
3. Canine. 8. Wisdom tooth.

(Note that 6 (the 6-year-old molar), 7 and 8 do not replace any of the temporary teeth.)

in length and width, particularly in length. Whereas at the age of 2, the back temporary molars were located at the extreme ends of the jaws, by the time the child has reached the age of 5 or 6, the growth of the jaws in length has provided spaces behind these temporary molars of sufficient size to accommodate the much larger permanent molars, which will later erupt.

Between the ages of 5 and 7 the four 6-year-old molars make their appearance, and it is a point of importance to note that these, the first of the permanent teeth to erupt, do not replace any temporary teeth, but come into position posterior to the existing temporary molars. These four teeth, when fully erupted, form fixed points in the growing jaws, before and behind which the successive permanent teeth take their places, and their importance in laying the foundation of well-shaped jaws has led to them being described, not inaptly, as the " keystones of the dental arch."

They are, however, very commonly regarded by parents as part of the temporary dentition, because their advent at the back of the mouth has been unobserved, but the necessity for watchfulness in regard to their decay, and for their early treatment when decay has commenced, can hardly be overstressed in view of their importance in the completed dentition.

Following quickly upon the eruption of the 6-year-old molars, the change of dentition begins, the temporary teeth being shed in order to make room for their permanent successors. This process, which begins with the central incisors at about the sixth year, and ends with the replacement of the temporary canines (or eye-teeth) at about the twelfth year, is accomplished by means of the absorption of the roots of the temporary teeth.

Contrary to popular belief, the oncoming permanent teeth do not push out their temporary predecessors, with which, as a matter of fact, they do not come into contact at all. When a permanent tooth is sufficiently developed to withstand the strain of mastication, a pad of connective tissue containing large bone-destroying cells (osteo-clasts) is formed between it and the root of the temporary tooth about to be superannuated. The material of this root is then dissolved by the osteo-clasts and carried away by the blood stream, until finally, the temporary tooth is shed owing to the destruction of its anchorage. The significance of this distinction between " falling out " and " absorbing out " lies in the fact that the absorption process can only take place in living, more or less healthy, teeth. When decay in temporary teeth has been allowed to progress until the " nerve " of the tooth has become infected, with consequent destruction of its vitality, root-absorption cannot take place and the tooth will not " fall out " at the proper time. On the contrary, it, or the remains of it, will form an obstruction in the path of the oncoming permanent tooth, forcing the latter to erupt out of alignment.

At the age of 13 the permanent dentition should be complete, with the exception of the four "wisdom" teeth, which may erupt at any age from 17 onwards, and may even, in certain cases, never erupt at all. At this stage the dentition comprises 28 teeth, or 14 in each jaw, as follows:—

2 central incisors
2 lateral incisors
2 canines (eye-teeth)
4 premolars (bicuspids)
4 molars.

All the incisors and canines have single roots, whilst the premolars may have one or two roots. The molars in the upper jaw have three roots, but those in the lower jaw have two roots only.

STRUCTURE OF THE TEETH. Each tooth has a crown, which is the visible portion, and one or more roots embedded in the gum and the bone. The outermost layer of the crown, the *enamel* or "ivory," is composed solely of prisms of lime salts cemented together, and underneath this lies the main body of the tooth, called *dentine*. Dentine is a structure similar to bone, containing innumerable tiny tubes radiating from the pulp or "nerve" in all directions, each of them carrying a prolongation of pulp-tissue. It is therefore, to this extent, a living structure, unlike the enamel which is purely inorganic, and it shares with the other vital parts of the body the power, under certain circumstances, of arresting disease by which it is attacked.

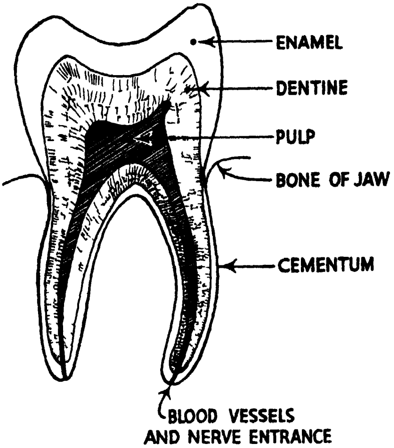


FIG. 45. *The Structure of a Tooth.*

The *pulp*, the truly vital part of the tooth, is a highly vascular mass of connective tissue, containing nerves and irregular lymph-spaces. The blood vessels and nerves enter the pulp through a minute aperture at the apex of the root. The root of the tooth is composed of dentine, over which is laid a thin layer called "*cementum*." Cementum contains connective tissue fibres which are continuous with the periosteum of the tooth socket, and by this means the attachment of the tooth to the bone of the jaw is secured. These fibres do not, however, run directly horizontally, but at an angle, and in this way a cushioning effect is produced, for the purpose of absorbing the shock of mastication. Lack of efficient mastication leads to a deterioration in the elasticity of these fibres, and in such circumstances the tooth may become more or less rigidly fixed to the jaw bone, this condition being frequently a precursor of pyorrhœa.

During the evolution of the respective species of animals, the shapes and sizes of the crowns of the different teeth have been determined by the functions which they have been required to perform. Carnivora, for instance, possess only teeth adapted to the seizing, tearing, and cutting of flesh ; herbivora, on the other hand, possess principally broad, grinding teeth with the addition of a variable number of incisors adapted for seizing vegetable food. Extreme cases of this differentiation are furnished by the spike-like teeth of the crocodile and the enormous molars of the elephant.

Man is a mixed feeder, and, in consequence, his dentition comprises adapted examples of both types. The central and lateral incisors represent the prehensile teeth of both the carnivora and herbivora, the canines are examples of the meat-eater's teeth, whilst the molars are of the true herbivorous type. In between the canines and the molars come the premolars, having to some extent the characteristics of both kinds, being furnished with two cutting points and a small grinding surface.

It is a point of importance to remember that all teeth are designed to work in pairs, one in the upper and one in the lower jaw, each as much the complement of the other as are the blades of a pair of scissors. The loss of one tooth, therefore, means the loss of function of the corresponding tooth in the opposite jaw.

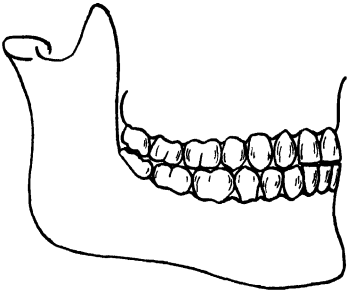


FIG. 46. *Diagram showing how the Permanent Teeth of the Upper and Lower Jaws meet.*

Influence of Diet. The ability of a tooth to resist decay, in the presence of circumstances favourable to the condition, depends on the strength of its outer enamel coat. Calcium for the formation of the enamel prisms is obtained from the blood stream, but it only becomes assimilable from the diet through the action of Vitamin D, and unless this is present in sufficient quantity, the amount of calcium available for tooth building will be insufficient, no matter how much may be taken with the daily meals.

To ensure the necessary absorption of the calcium, the diet should include milk, butter, cheese, green vegetables and salads, fatty fish, such as herrings or mackerel, and eggs. To some extent the development of the temporary teeth depends upon the health of the mother, and it is essential, therefore, that the diet of expectant and nursing mothers should include the types of food mentioned.

The diet of the baby from six months up to one year should consist of mother's milk supplemented by an increasing amount of solid food that can be gnawed, such as crusts, toast, and buttered but unsoaked rusks. From two years of age onwards the child's diet must also include food materials containing sufficient Vitamin D to ensure the absorption of the calcium salts necessary for the proper enamel formation of the permanent teeth.

Dental Caries, which constitutes the most prevalent of all human ailments, is the name given to the progressive destruction of tooth substance, brought about by chemico-bacterial agency. The widespread nature of the complaint is illustrated by the fact that over 80 per cent. of school children of all ages require treatment for it.

This disease in its origin is purely chemical in nature, comprising a simple decalcification of the tooth-enamel. Starchy foods in the mouth are converted by the ptyalin of the saliva into sugars, and if these sugars are allowed to remain in the mouth, they will be fermented into lactic acid through the action of the bacteria present in the mouth. A condition of local acidity is thus set up which will begin the process of caries by dissolving the enamel. Under ideal conditions, the small amount of lactic acid existing in the mouth will be neutralized by the natural alkalinity of the saliva. Lack of cleanliness of the teeth, too great a proportion of starchy food in the diet, or the absence of fibrous food which helps to cleanse the teeth, are factors which favour retention of fermenting food between the teeth, and the formation of excessive lactic acid.

At the commencement, the decay is merely about the size of a pinhole, and if it is recognized at this early stage, its repair by filling is an easy and painless proceeding. In the course of time, perhaps only a few months, the decay, if unchecked, progresses to such a depth that the underlying dentine becomes involved (Fig. 47A), and a little toothache is probably experienced. Treatment, even in this stage, is usually a fairly simple and painless procedure, the decayed tissue being removed and the cavity filled after previous disinfection.

If the decay be still further neglected, it progresses until the pulp cavity is reached (Fig. 47B), when the pain becomes much more intense. The pulp, having become involved, dies, and sepsis may spread along the root canal until an abscess forms at the root (Fig. 47C).

Dental abscesses may be acute or chronic in nature. If

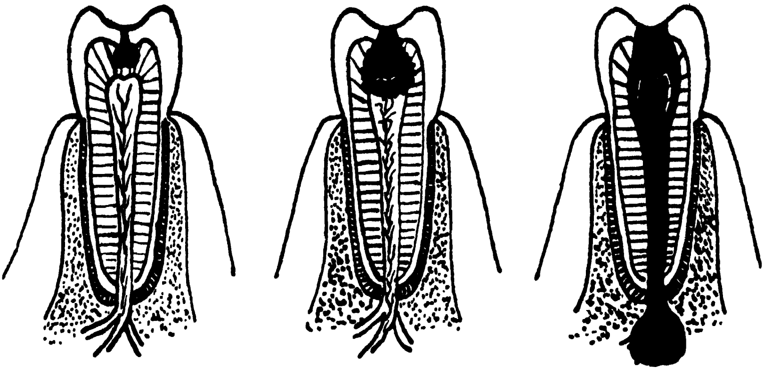


FIG. 47A. FIG. 47B. FIG. 47C.

Diagrams showing progressive stages of Dental Decay.

the infection be of a virulent type, the familiar symptoms of pain and swelling will be present; the pus from the abscess will burrow into the surrounding tissues, and in many cases cause a "gum-boil". If the infection, on the other hand, be of a less virulent degree, the abscess may become encapsuled at the apex of the root and its presence be unrecognized. This condition is, however, no less injurious than the acute form, and, in fact, may have a more lasting ill-effect upon the health of the individual. There occurs in these cases a constant absorption of pus into the lymphatic system, which leads sometimes to the establishment of septic foci elsewhere, and gives rise to a general condition of ill-health and lack of efficiency.

Among the more serious results which may follow upon such a condition may be mentioned :—

(*a*) Enlarged glands under the jaws and in the neck. These glands act as filters to prevent bacteria and their toxins from entering the blood stream through the lymphatic system, and their enlargement shows the strain to which they are being subjected. If this strain be not relieved by the removal of the septic focus the glands may eventually break down and suppurate, or they may even become a site for tuberculous infection.

(*b*) Anæmia and digestive or other alimentary troubles.

(*c*) Debility and nervous symptoms.

(*d*) Auto-intoxications, brought about by the constant absorption of toxins and producing symptoms similar to rheumatism. Occasionally such auto-intoxication may give rise to serious eye diseases, such as iritis.

Prevention of Caries. Since dental caries begins as a simple chemical reaction, conditions should be maintained in the mouth which do not favour such a reaction. The prevention of caries in soundly calcified teeth can only be effected by strict attention to the nature of the diet, the proper mastication of the food, and cleanliness of the mouth. The type of food pre-eminently favourable to fermentation, when left in contact with the teeth, is that containing carbohydrates in a soft and sticky form. The crumb of white bread, pastry, soft biscuits, and potatoes are all potential sources for the production of lactic acid, inasmuch as particles of them readily adhere to the teeth and are difficult to dislodge. Bread-crusts and toast, on the other hand, are types of food which not only have much less tendency to cling to the teeth, but also, because of their relative hardness, tend to dislodge the softer materials. Underdone meat, green vegetables and fresh fruit, owing to their stringy, fibrous nature, form types of food which are extremely valuable from the dietetic point of view because of their cleansing properties.

Children should therefore be encouraged to eat the crusts of bread, hard toast, and fresh fruit. They might also, with advantage, finish every meal with a portion of apple, the fibrous nature of which will tend to clean the teeth by natural methods.

No food should ever be swallowed which has not been properly masticated, since this is essential, not only for proper digestion in the stomach, but for the well-being of the teeth themselves, for it assists the removal of debris from between them, and strengthens their fibres of attachment to the bone, and in this way lengthens their life.

Artificial cleanliness can only be obtained by means of the tooth-brush, and this should be of an adequate size and a suitable shape, so as to be able to reach *all* the surfaces of *all* the teeth. The bristles should be of a medium hardness and the strictest cleanliness with regard to the keeping of the brush must be observed. The most important time for the use of a brush is before retiring for the night, since it is during the hours of sleep that the processes of decay are most active, because of the cessation of the movements of lips and tongue, which conduct saliva into all the crevices in and between the teeth.

Expensive dentifrices are not essential, since the only function of a dentifrice is as a cleansing agent ; camphorated chalk, which is quite cheap, is a perfectly satisfactory adjuvant to the tooth-brush. The brush should be used with an up-and-down movement in order to get the bristles of the brush between the teeth and so remove any food particles lodging there.

SCHOOL DENTISTRY

THE aim of school dentistry is two-fold. Firstly, by means of suitable propaganda to inculcate the principles of dental hygiene, and secondly, by a system of regular inspection and treatment, to ensure that the children arrive at the school-leaving age with healthy mouths and a sound dentition.

The one fundamental necessity for successful treatment is regularity of attendance. In a satisfactory school dental service every child from the age of 5 or 6 onwards is subjected to a dental inspection at least once annually. On the occasion of a child's first visit to the clinic, it is quite commonly found necessary to extract diseased and septic temporary teeth. At subsequent visits, if the child attends promptly, whenever advised, extractions should seldom be required. The dental officer is thus able to treat any carious permanent teeth before much damage has been done, and the child is helped to retain a sound and healthy second dentition.

The filling of teeth, which is usually carried out in children by means of copper or silver alloyed with mercury, is a painless and effective remedy if applied in time.

In an ideal dental scheme the teeth of the children would be examined twice a year, but on account of the great cost involved, this has not yet become the usual practice, and it is customary for this examination to be carried out once a year only. In the great majority of cases, when the children attend regularly for treatment, this is sufficiently often to enable the dental officers to save the teeth affected. But if, through failure to accept treatment in any one year, the teeth go for two years without treatment, the caries will in most cases have spread to an irreparable degree. It will be readily understood, therefore, that if the teeth are to be saved and the child's mouth preserved in a healthy and functioning condition, an acceptance of treatment on behalf of the child must be made immediately the parents are notified of its necessity.

Co-operation by the teachers can be of very great service in impressing the children, and through them their parents, with the necessity for practising the simple rules of dental hygiene, and the desirability of always accepting the offer of dental treatment when made by the Education Authorities.

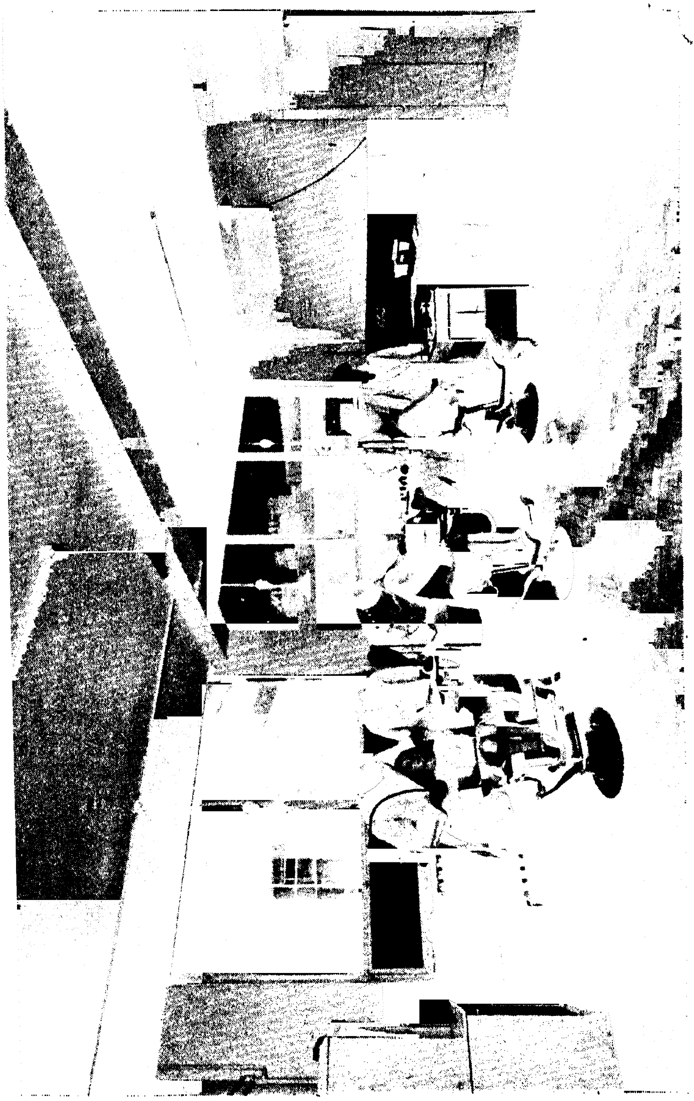


FIG. 48. *A School Dental Clinic.* (For the purpose of this illustration the chairs were turned round. In practice they face the windows.)

CHAPTER 16

AFFECTIONS OF THE SKIN AND GLANDS

Impetigo. Ringworm. Alopecia areata. Scabies. Chilblains. Enlarged glands.

IMPETIGO

IMPETIGO, which is a contagious disease of the skin due to infection either by streptococci, or staphylococci, occurs most commonly amongst the younger children of the poorer classes, especially boys. Its contagiousness appears to vary considerably, but usually this risk is comparatively small, although in some instances the disease may spread through a class or family. It sometimes occurs in outbreaks at boarding schools where Rugby football is played, and it is then spoken of as " Scrum-pox ".

The lesions usually occur on the face or scalp, but may also appear on any other part of the body. At the commencement blisters form, the contained fluid rapidly drying up and leaving honey or amber-coloured crusts, which appear as though they were stuck on. When it occurs on the scalp it is frequently the result of infection introduced as the result of scratching caused by the irritation of lice. The lymphatic glands draining the affected parts usually become inflamed and enlarged, and unless the sores receive efficient treatment, the inflammation may go on to abscess formation.

There are various methods of treatment, the underlying principles of all being the removal of the crusts by starch poultices or other means, and subsequent disinfectant treatment of the raw surface left, by means of ointments or lotions,

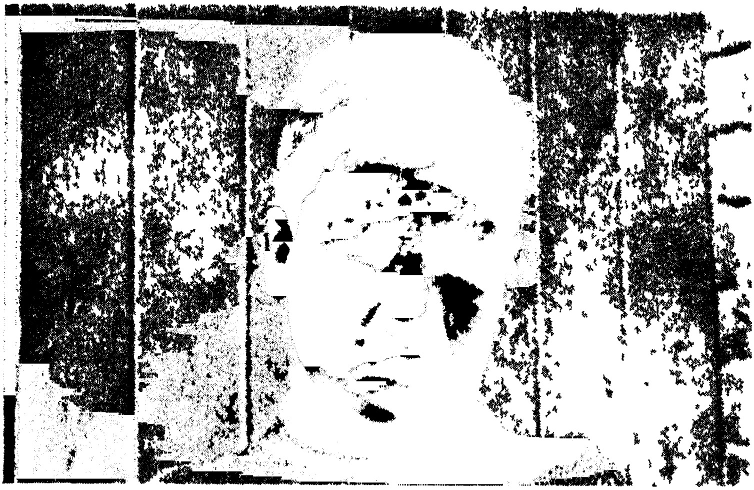


FIG 49. *Impetigo of the Face.*

the most usual being ammoniated mercury (white precipitate) ointment. In the case of debilitated children, some form of cod liver oil taken internally will expedite the cure. Most cases can be cured in about two weeks, but the children should be excluded from school while suffering from the disease.

RINGWORM

RINGWORM is a parasitic disease due to a fungus which may affect the skin of the body or the scalp. *Body ringworm* commences as a small reddened patch, and is characterized by the fact that, while extending at its margins it is healing at the centre, and thus is produced the more or less ringed formation from which the disease derives its name. Sometimes several places are affected close to one another, and as the separate rings extend the margins coalesce and produce irregularly-shaped areas. Body ringworm is easily cured, perhaps the best-known treatment being the application of Tincture of Iodine.

Scalp ringworm is characterized by the presence of some round, and more or less bald patches on the scalp, which are covered with scurf or scales, amongst which may be seen the ends of some hairs which have broken off short, for the fungus has extended down the hair follicles to the roots and interfered with the nourishment of the hairs, causing them to become brittle.

It is by no means always an easy matter to diagnose the condition or to recognize when it is cured. In any case of doubt, suspected hairs should be examined under the microscope, which will reveal the spores of the fungus, if present. Another valuable help in the diagnosis is the illumination of the scalp in a dark room by means of the ultra-violet rays passed through a special filtering glass called Wood's glass. If ringworm be present, the hairs affected take an a phosphorescent glow.

As ringworm may be spread by caps, brushes, combs, towels and pillows, children affected should have such articles strictly retained for their own personal use. The hair should be cut short, and the hat or cap worn should have a detachable linen lining, which can be changed daily and boiled before being worn again, or a paper lining may be used, which can be burnt at the end of each day. Although a few authorities permit affected children to attend school wearing a protective cap, it is probably safer to exclude the children until the disease is cured.

Owing to the fact that the fungus extends down to the hair roots, the condition is exceedingly difficult to cure, as ointments and lotions cannot reach the hair roots, and when only such methods of treatment were available, many cases resisted treatment for several months, and even for years. The modern method of treatment by means of the X-rays has cut down the time required for a cure to a few weeks. The hair over the affected areas treated falls out by the roots and brings out with it the ringworm fungus. When the new

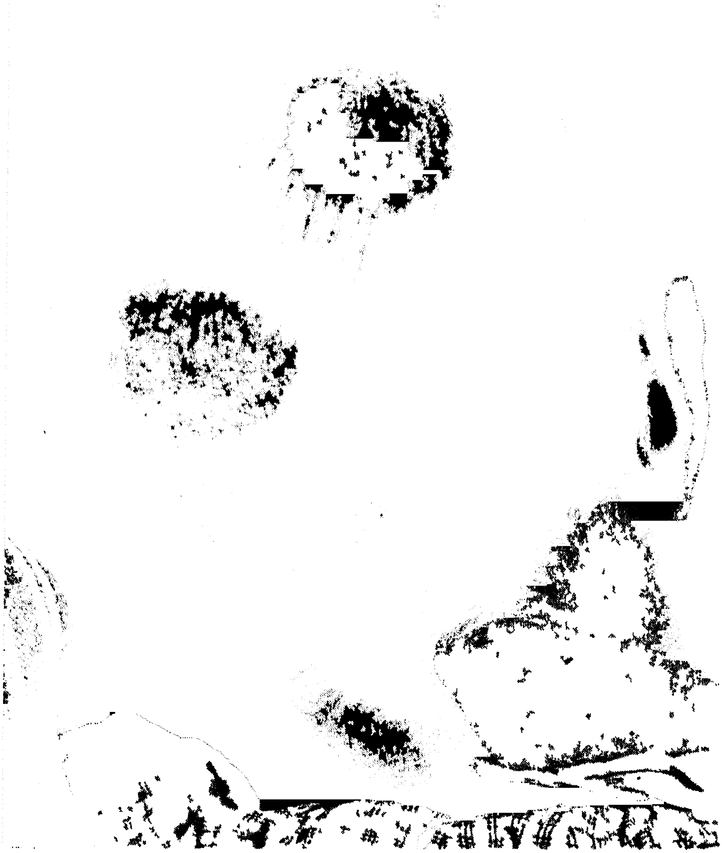


FIG. 50. *Ringworm of the Scalp.*

(From R W MacKenna's "Diseases of the Skin," by permission of Messrs. Baillière, Tindall & Cox)

hair subsequently grows, it is nearly always found that the disease has been cured.

It is important that children showing any suspicion of a bald, scurfy area on the scalp should be referred at once to the school medical officer for examination. The disease is much more common among boys than girls, and it is not associated in any way with dirt, in fact, dirt on the scalp would probably act as a protection rather than render the scalp more susceptible. The disease was very prevalent some twenty years ago, but of recent years has been reduced to quite small proportions, probably because the more rapid methods of curing the cases have reduced the possibilities of infection.

ALOPECIA AREATA

Alopecia areata is a condition of the scalp in which the hair falls out in patches and, on this account, is often mistaken for ringworm. The bald patches, however, are smooth and shiny, and not scurfy, as in the case of ringworm, but there may be, especially round the edges, evidence of hairs which have broken off short. These broken hairs differ from ringworm-infected hairs by being thicker at their free ends than they are near the scalp, and resemble "marks of exclamation." The cause of the condition is not known, but is thought to be associated with some disturbance of the nerve supply of the scalp. As it is not contagious, it is not necessary to exclude the cases from school. The disease usually persists for several months, but may last for some years. The treatment is by the use of applications which stimulate the blood supply of the area, or by exposure to the ultra-violet rays. In a few cases injections of pituitary gland appear to have been beneficial, which suggests the possibility that an insufficiency of the hormone secreted by this gland may be responsible for some of these cases.

SCABIES

Scabies (Itch) is a contagious skin disease caused by a minute insect called the Acarus scabiei, and is characterized by the presence of short burrows under the superficial layer of the epidermis, and in these burrows the female deposits her eggs. Sometimes the skin over the end of the burrow is raised into a small vesicle. The lesions are chiefly found in the webs of the fingers, the fronts of the wrists, between the toes and round the ankles, and at places where pressure of clothing occurs, such as under waist belts or garters. Less commonly the infection occurs between the buttocks and in the axillary folds. Burrows may also be found in other parts of the body, though it is characteristic of the disease that the face is never affected. The patient's attention is first drawn to the condition by intense itching, which comes on after getting warm in bed, and to relieve it the patient scratches the irritating parts, causing scratch marks, and, later, pustules due to secondary bacterial infection.

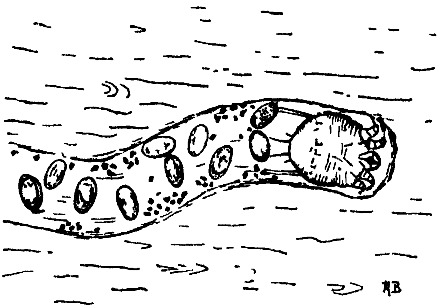


Fig 51. *The Female Acarus in its burrow in the skin.*

(From R W MacKenna's "Diseases of the Skin," by permission of Messrs Baillière, Tindall & Cox)

The disease is spread almost entirely by direct contact, though it may be spread by infected clothing and bedding. It is a mistake to think that only persons of uncleanly habits contract this infection. When once a case occurs in a household it is quite common for most of the members of the family to contract it.

Since the disease is so often a family infection, its eradication necessitates the simultaneous treatment of all the members of the family affected, and some authorities have

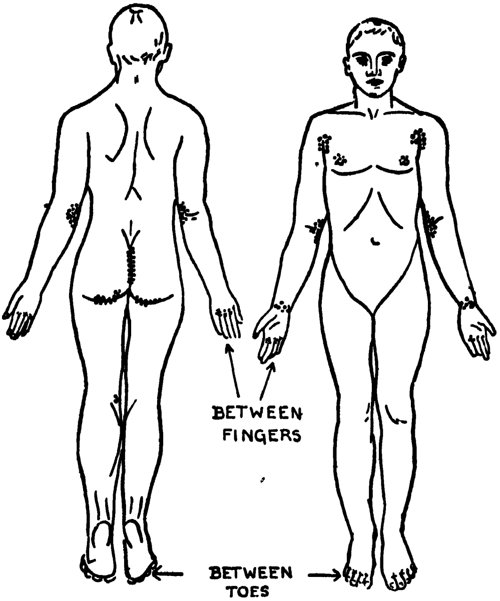


FIG. 52. *Diagram showing the usual sites of the Lesions in Scabies.*

(From R. W. MacKenna's "Diseases of the Skin," by permission of Messrs. Baillière, Tindall & Cox.)

provided special clinics where this can be carried out, and the clothing and bedding disinfected.

The treatment consists of soaking the body in a hot bath and vigorously rubbing the skin over the lesions with a nail brush or loofah in order to break down the burrows, after which all the skin areas, with the exception of the face, are thoroughly rubbed with sulphur ointment. This treatment should be carried out on three consecutive days, after which there must be a complete disinfection of all clothing and bedding. That sulphur ointment is a valuable method of treatment is well known, and it is not uncommon to find that in cases where the parents themselves undertake this form of treatment, the condition is reported as apparently not yet cured after several weeks or months. The explanation is that the scabies infection has really been cured, but the lesions present are a form of eczema caused by an excessive use of sulphur ointment. When this ointment is discontinued and a soothing ointment, such as zinc ointment, substituted the condition soon clears up.

CHILBLAINS

CHILBLAINS are localized but persistent areas of congestion of the skin occurring mainly on the fingers and toes during periods of cold weather, especially in children whose circulation is poor. They appear as small red or livid shiny swellings which itch intensely. In the more severe cases blisters may form on the swellings, and when these break, ulcers may form which are very difficult to heal. In persons who are susceptible to them, chilblains are often brought on by warming the hands or feet too quickly in front of a fire. Sitting in school with cold or damp feet in cold weather is often an exciting cause, and it is most advisable that susceptible children should retain at school a pair of dry stockings and shoes, for use when necessary.

There is no known specific cure for the condition though many different remedies have been tried, such as painting with tincture of iodine, and the internal administration of calcium salts. As preventive measures the following are of some value: cod liver oil and malt, exposure to ultra-violet rays, moderated exercises, the wearing of thick but not tightly-laced boots, and warm but loose-fitting gloves and stockings.

PEDICULOSIS

FROM the commencement of the School Medical Service one of the biggest problems with which it has been faced has been that of eradicating verminous infection of the body and clothing (pediculosis), which formerly was so prevalent amongst the children attending the public elementary schools. Strange views are still held by ignorant people with regard to the presence of these parasites, such

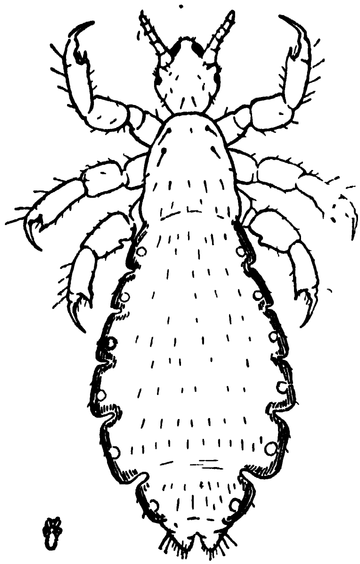


FIG. 53. *Head Louse, showing the natural size and magnified twenty times.*

(*From "The Louse as a Menace to Man," by permission of the British Museum, Natural History Section.*)

as, that their presence is a sign of health, or that they develop and come out of the blood, or again, that no people are free from them. Though lice are usually found on dirty people, uncleanliness is not the cause of the condition, since the parasites can neither originate from, nor feed on dirt. The co-existence of dirt and vermin is due to the same cause, namely personal neglect. A study of the life-histories of the head louse and the body louse will make this statement clear.

The HEAD LOUSE (*pediculus capitis*) is a small flat-bodied insect with a tough skin and six legs ending in powerful claws. It has a mouth specially designed for piercing the skin in order to suck blood, which is its only food, and for this reason it soon dies when separated from its host. As the adult female louse lays some 8-12 eggs per day, and its life is about four weeks, accidental infection by one such louse will, if not dealt with, result in a gross infection in the course of a few weeks. The eggs, which are known as nits, each of which is the size of a

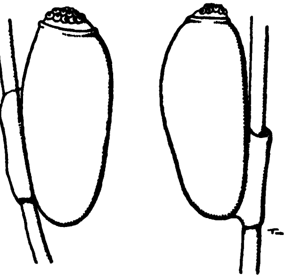


FIG. 54. *Eggs of a Louse (Nits) attached to hairs.*

(*From "The Louse as a Menace to Man," by permission of the British Museum, Natural History Section.*)

pin's head and yellowish-white in colour, are firmly attached to the hairs by means of a quickly hardening, sticky cement. A nit is more or less conical in shape, and is cemented at its narrow end to a hair. The broad end of the nit, which is always the end furthest away from the scalp, is closed by a lid, which the larva opens when emerging at the end of about seven days. Before attaining maturity the young louse moults three times at intervals of a few days.

The Body Louse (*pediculus corporis*) is in appearance very like the head louse and has a similar life history. Its eggs (nits), however, are laid on and affixed to the fibres of the underclothing, the neighbourhood of the seams being favourite sites. As this louse lives mainly on the underclothing, though going on to the skin to feed, it will be seen that it should be comparatively easy for clean people to keep free from the body louse by wearing separate night garments and frequently changing the underclothing, as any chance vermin which might have gained access would thus be removed.

In the case of the hair, however, in order to ensure freedom, it should be combed with a fine-toothed steel comb at least once a week, in order to remove not only any stray lice which may have gained access, but also any nits which may have been deposited. Ordinary brushing and combing and occasionally washing the hair is not sufficient, on account of the firmness with which the nits are cemented to the hairs.

Infection, though spread mainly by direct contact, may also be spread indirectly by infected caps or hats in the case of the head louse, or by infected articles of clothing or bedding in the case of the body louse.

Infection of the hair, especially in the case of girls, is much more frequent than infection of the body and clothing, which is more common amongst boys than girls.

The direct effects of pediculosis include irritation and scratching, restlessness and loss of sleep, and inattention at school. The more important secondary effects are the production of such skin affections as impetigo and sores, resulting from an infection of the skin due to scratching. Enlargement of the glands of the neck is quite common, and anæmia and general debility may also result. Certain serious diseases may be spread by the bites of body lice, namely, typhus, relapsing and trench fevers.

The TREATMENT of the condition depends upon whether the infection be due to the head or the body louse.

(*a*) *Infection of the Head.* Formerly it was the practice to apply to the head sassafras oil, pomades, vinegar, and shampoos containing paraffin oil, in order to kill the parasites and their eggs, after which the head was combed with a fine bone tooth-comb. These bone combs, however, were not really satisfactory in removing the nits, and it was often necessary to cut some of the hair away. There are now on the market several types of fine steel tooth-combs by means of which both the lice and nits can be expeditiously removed without the need for such preliminary applications, or for cutting the hair. To facilitate the combing, the head should be thoroughly washed with soft soap, leaving the lather on for some minutes, but this should be washed off before combing. If properly carried out in this way, even a grossly infected head can be completely cleansed of lice and nits in about half an hour.

(*b*) *Infected Clothing* can best be treated in a steam disinfector, if such be provided by the local authority, or can be dealt with at home by wrapping the garments loosely in paper and putting them in a slow oven with the fire dying down. Washable clothing may be dealt with by immersing it in cold water, and raising the temperature until the water steams, but boiling is not necessary. Another method which is useful for such articles as jackets, which cannot be washed, is to iron them with a hot iron, particular attention being given to the seams, where most of the nits are usually found.

(*c*) *Infected Bedding* can only be satisfactorily dealt with in a steam disinfector.

An important part of the work of the school nurses is the supervision of the school children with regard to uncleanliness and verminous conditions, for which purpose they make periodical inspection of all the children in the schools.

Section 87 of the Education Act, 1921, empowers any local education authority to authorize the school medical officer, or any person provided with his authority in writing, to examine the persons and clothing of public elementary school children. In the case of the person or clothing of any child being found to be infected with vermin, or in a foul or filthy condition, the local authority may give notice in writing to the parent, requiring him to cleanse properly the person or clothing of the child within 24 hours of the receipt of the notice. If the notice be not complied with, the child may be compulsorily removed from the school to suitable premises by some authorized person and there cleansed. If, after such compulsory cleansing the child is again allowed to become verminous or unclean, the parent renders himself liable to prosecution. Many local authorities provide cleansing stations where children can be cleansed, either voluntarily by the parents, or compulsorily under the above-mentioned section of the Education Act.

Another method of dealing with such cases, adopted by some authorities, is to exclude the children from school, and if the children are not cleansed forthwith, to take action against the parents under the Attendance Bye-laws for not putting their children in a fit condition to attend school.

ENLARGED GLANDS

THE lymphatic glands are small masses of lymphoid tissue, placed along the course of the lymphatic vessels, through which the lymph has to pass on its way to join the blood stream. The glands perform the dual function of manufacturing white corpuscles, and acting as filters to prevent foreign particles, such as bacteria, from gaining access to the blood stream by way of the lymph channels.

The lymphatic glands are either (*a*) superficial, or (*b*) deep seated.

(*a*) The *superficial lymphatic glands* lie in the subcutaneous tissue. The chief ones of the upper extremities are in the neighbourhood of the elbows and in the armpits, and the chief ones of the lower limbs behind the knees and in the groins. In the neck there are a considerable number, some at the back of the neck, which act as a filter for the lymphatics from the back of the scalp, others lie under the jawbone, and there are a number of glands called the superficial cervical glands which lie in a lengthwise direction between the ear and collar-bone and drain the lymphatics from the mouth and tonsils.

(*b*) The *deep lymphatic glands* are chiefly found in the chest and abdomen, and also in the neck. Those in the chest are found in the neighbourhood of the bronchial tubes (bronchial glands) and they serve to drain the lymphatics from the lungs. Those in the abdomen, known as the mesenteric glands, drain the lacteals from the intestines.

The following example demonstrates the action of the glands. If, as the result of a cut or a prick on the finger, bacteria are introduced into the subcutaneous tissue, and get into the lymphatic channels of the finger and forearm, they are carried along until they reach a gland in the neighbourhood of the elbow, where they are arrested and attacked by the phagocytes of this gland. If the phagocytes are easily able to overcome the invaders nothing further happens. But should the struggle be a more difficult one, the gland becomes tender, inflamed and swollen ; and if the defences of this gland be overcome, the bacteria are carried along the lymphatics of the upper arm until they meet the next line of defence at the axillary gland. There a similar engagement takes place, and if the defensive forces of these glands be overcome, the position becomes serious, as the invading bacteria have no further obstacles in their way to prevent their entry into the blood stream and thus setting up general blood poisoning.

In the process of dealing with invading organisms the glands may break down to form an abscess, the pus of which is largely composed of dead and dying phagocytes and the bacteria which they have engulfed.

The glands of the neck are the ones most frequently enlarged, as the result of bacteria and their poisons gaining access to the lymphatics through carious teeth, unhealthy tonsils or adenoids, and septic sores on the scalp due to pediculosis. Frequent infections of the glands lead to their chronic enlargement, and in this condition they are more liable to become infected by tubercle bacilli. The deep glands in the abdomen and the chest are also liable to tuberculous infection.

VERRUCÆ (WARTS)

Warts are probably caused by a virus which gains access to the skin through minute abrasions. When these occur on the plantar surface, or sole, of the foot they are known as verrucæ, or plantar warts. This type is tender to touch, and being usually located on the ball or heel causes pain on walking. The warts appear to be spread and contracted through walking in bare feet in swimming baths, changing rooms or dancing classes.

When cases of verruca occur in a school, all the children's feet should be regularly inspected, and all surfaces upon which the children walk in their bare feet should be frequently disinfected.

In residential schools cases should have a separate dormitory, bathroom and changing room, and their own towels for drying and standing upon. Their footwear should be kept apart from, and cleaned after, the other children's.

CHAPTER 17

MALNUTRITION, ANÆMIA AND OPEN-AIR SCHOOLS

Signs, causes and treatment of subnormal nutrition. Provision of meals. Types, causes and treatment of Anæmia. Descriptions of open-air schools and cases suitable for them.

MALNUTRITION

THE term " malnutrition " means literally bad nutrition, and whilst some medical men reserve this term for those cases in which there is a marked deviation from normal nutrition, others include under it cases which are only slightly subnormal. Consequently, it is not surprising to find from a perusal of the annual reports of the medical officers of the different education authorities throughout the country that the proportions of children reported as suffering from malnutrition show considerably wide variations.

Local conditions, such as the type of neighbourhood, will undoubtedly account for some variation, for one would naturally expect fewer cases in a purely residential area than in an industrial area, but this factor alone does not account for the wideness of the variations. The explanation of these apparent discrepancies is that there is no recognized standard of normal nutrition nor of malnutrition. Between normal nutrition and marked cases of malnutrition there are many gradations, and in the absence of a practical standard the classification has to be dependent upon the personal opinions of the observers, which cannot be standardized. An impression, however, of the prevalence of malnutrition amongst school children throughout the country can be obtained from the reports of the Medical Officer of the Board of Education. In the Report for 1933 it is stated that not less than 1 per cent. of the children attending school are malnourished, and that approximately another 4 per cent. are slightly undernourished.

Various formulæ for estimating normal nutrition and deviations from the normal have been devised, notably by Dreyer in this country, Von Pirquet on the Continent, and Emerson and Holt in the United States, but as the practical application of these formulæ requires not only somewhat elaborate measurements, but also somewhat complicated mathematical calculations, they must be regarded as of scientific rather than of utilitarian value.

In estimating nutrition it is not merely a question of ascertaining whether or not the child's height and weight are equal to the average for its age, but the functioning of the various systems of the body has also to be taken into consideration. In appearance the normal healthy well-nourished child is robust, has a good complexion, bright eyes and glossy hair. The body should be evenly covered with subcutaneous fat, the muscles should be firm, and the carriage erect. The appetite and digestion should be good and the bowels regular. The child should be active in the day time and sleep well at night.

On the other hand, a child suffering from malnutrition manifests some of the following characteristics. The height and weight may be below the average, especially the weight. In appearance the child looks delicate and has a sallow, unhealthy complexion, whilst the mucous membranes may show evidence of pallor. When there is a lack of subcutaneous fat, the skin is loose and the ribs stand out prominently. The hair may be coarse and lacking in lustre, the muscles poorly developed and flabby. The lack of tone in the muscles may lead to incorrect postures being adopted, such as round shoulders. The child quickly tires both physically and mentally, is listless in school, and has poor power of concentration. Malnourished children are apt to suffer from catarrhal conditions of the respiratory tract, and their resistance to bacterial infection is diminished.

With but few exceptions the majority of children are born healthy, and if properly cared for, will develop into well-nourished adults. Formerly, it was customary to attribute malnutrition in childhood mainly to insufficient food due to poverty, but it is now known that there are many other contributory factors, such as certain physical conditions, including rickets, tuberculosis, and other acute and chronic diseases, septic teeth or adenoids or unhealthy tonsils; environmental causes, comprising lack of sunlight, sleep, and exercise, overcrowding and sleeping in ill-ventilated bedrooms. An unsuitable dietary due to ignorance of food values is also an important cause. Thus, tea is often drunk instead of milk or cocoa; canned foods and tinned milk are largely consumed instead of fresh. There is also in many of the children's diets a conspicuous lack of first-class proteins, animal fats, and fresh green vegetables and fruit, with their associated vitamins and mineral salts.

An intelligent mother can undoubtedly do far more for her family in the way of expending her money to the best advantage than one who is feckless, though there is, of course, a financial limit below which an adequate dietary cannot be obtained, however intelligent the mother may be.

Furthermore, particularly of recent years, there appears to be an increasing lack of parental control; many children are often not pressed to eat the nourishing food provided, such as meat and vegetables, but allowed to eat just what they like, and go to bed when they choose. Many young children regularly retire two or three hours after the time that children of their age should be asleep in bed.

In the treatment of malnutrition the first step is to ascertain the cause, by carrying out a thorough medical examination of the child, and by ascertaining from the parents the child's mode of living. Any disease or physical defects discovered will require treatment, errors of diet should be corrected, and if thought necessary, the school nurse will be requested to visit the home with the object of advising the mother how to carry out any instructions given by the medical officer with regard to diet, sleeping accommodation, ventilation, etc.

It may be necessary to advise extra nourishment in the form of milk or cod liver oil, convalescent treatment, or the transfer of the child from an ordinary school to an open-air school. In those cases where the malnutrition is due to inadequate or unsuitable food, the children may be provided with meals by the Education Authority.

As a method of dealing with the problem of malnutrition, the Borough of Wallasey has for some years held a *Nutrition Clinic* on the lines of similar clinics established by Emerson in New York. Describing this clinic, Dr. Barlow, the late Medical Officer, wrote that the children who attended were recommended by the medical or nursing staff, and at their first attendance they were weighed and measured in accordance with Professor Dreyer's method. Enquiries were made into such matters as the time of going to bed and getting up, the amount and nature of food taken, times of meals, bolting of food, and constipation. A clinical examination was then made, and any evidence of disease or defects noted. Each child who did not come up to the standard of weight was required to attend the clinic once a week or at longer intervals, and was weighed and measured on each occasion. Advice was given to the parents on all matters needing attention, and, in suitable cases, extra nourishment, such as milk or cod liver oil, was provided, whilst an endeavour was made to interest the child in his own condition. Special nutrition clinics have recently also been established by the School Medical Department of the London County Council.

PROVISION OF MEALS

UNDER Sections 82-85 of the Education Act, 1921, the power is given to local education authorities to aid or associate themselves with voluntary committees known as School Canteen Committees in providing meals for any children attending school, both on school days and on other days, provided that the authority incur no expense in the purchase of the food for such meals. They are also given power to provide meals for children attending elementary schools who " are unable by reason of lack of food to take full advantage of the education provided for them," and to defray the costs out of the rates. Parents are required to pay the whole or part of the cost of the meals if they can afford to do so.

The majority of authorities use these powers only with regard to providing meals for the children of necessitous parents, and supply dinners, or in some cases breakfasts, or more rarely breakfasts and dinners for such children. Many authorities supply milk in addition to the dinners, or milk alone.

The Board of Education require that the school medical service should be associated with the planning and administration of the arrangements, and that the dietary scales adopted should be approved by the School Medical Officer.

In the construction of dietary scales for the children of poor parents, it is important that the dinners should contain a proportionately larger quantity of those food constituents which are lacking in the meals taken at the homes, and it is desirable that these dinners should provide rather more than half the total calories required for the day.

In the majority of cases the children are supplied with meals either at the request of the parents or on the recommendation of the head teachers, and cases are also recommended by school medical officers or school nurses, members of care committees, etc. Naturally, as the class teachers see the children every day, they are in the best position

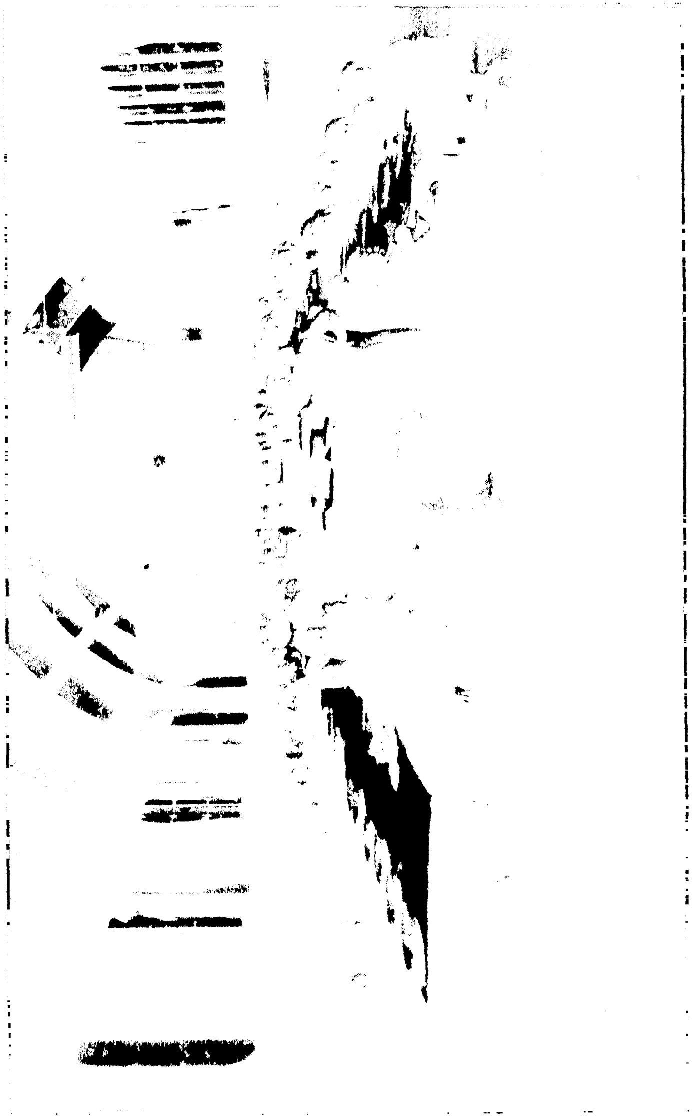


FIG. 55 *Mid-day Meal at a Dining Centre*

to observe any deterioration in the health, or the quality of the work of the children, and as they often have knowledge of the children's home circumstances they are often able to surmise that the children's condition may be due to lack of proper food. When cases are recommended for school meals, some home enquiries have to be made into the family circumstances, usually by school attendance officers or members of care committees. Most authorities adopt an income scale to guide them in deciding whether or not a parent should pay anything, and if so, how much, towards the cost of the meals, the guiding factor in such scales being the average weekly income per head after deducting the rent.

The Board of Education is of the opinion that, in the main, children should be selected for meals or milk on medical grounds, and for this purpose recommend that a periodical survey of the whole school population should be made from time to time, in order to discover those children who by reason of lack of food are unable to derive full benefit from their education.

The Board further suggests that all children receiving meals or milk should be kept under special medical supervision in order to determine whether or not the provision of meals or milk is still necessary.

The actual arrangements for carrying out the provisions of the Act differ in various areas, each authority making those arrangements which are best suited to local requirements. They comprise one or more of the following schemes :—

(1) When comparatively small numbers of children have to be catered for, the meals may be cooked at the Domestic Training Centres, where the meals are also served.

(2) When larger numbers have to be fed, the usual arrangement is for the meals to be cooked at one or more cooking centres, from which the food is transported to conveniently situated dining centres.

(3) In outlying districts or rural areas arrangements may

be made for the few children requiring meals to get them at the shops of local caterers.

The dinners should consist preferably of two courses, and should be rich in first-class proteins, fats and vitamins, which are the food constituents in which the meals which the children take at home are deficient. The meals should be well varied, so as to obviate monotony, and the dietary so devised as to provide that the same meal does not recur on the same day each week, in order that the children shall not know what meal will be supplied on any particular day.

The Board of Education emphasize the great nutritive value of the "Oslo breakfast," which, they state, is as good, or better, than many of the hot meals ordinarily provided in feeding centres. It comprises ⅔ pint of milk, 3 ounces or more brown bread, ¾ ounce margarine or butter, 1½ ounces cheese, raw vegetables (tomatoes, carrots, watercress, radishes, lettuce) and raw fruit, preferably oranges.

ANÆMIA

ANÆMIA is an impoverished condition of the blood affecting the red corpuscles, of which there are over five million in every cubic millimetre of blood in normal males, but somewhat fewer in females. In these red corpuscles there is an important iron-containing protein called hæmoglobin, which gives to the blood its bright red colour.

The function of the hæmoglobin is to take up oxygen from the air in the lungs and transport it to all parts of the body, and also to convey from the tissues to the lungs the carbon dioxide produced as a waste product of metabolism.

There is a constant destruction of red corpuscles taking place, mostly in the liver, whilst new ones are continually being formed in the red bone marrow, and possibly also in the spleen.

There are several different types of anæmia, which may be the result of affections of the blood itself, or of the organs concerned in the formation of the red corpuscles. The latter varieties are spoken of as Primary Anæmias, the conditions known as Chlorosis and Pernicious Anæmia being the best-known examples. More frequent are the former varieties known as the Secondary Anæmias, which, as the name suggests, are secondary to other causes, such as :—

(1) Undue hæmorrhage. This form is usually rapidly recovered from, even without treatment.

(2) An insufficiency of food, or a diet deficient in iron and copper salts, or in certain vitamins, such as occurs in cases of rickets.

(3) The result of acute illnesses, in particular diphtheria, nephritis, and rheumatism.

(4) The absorption of toxins, which may be produced as a result of septic teeth, constipation, or in cases of chronic suppuration, as may occur in cases of tuberculous glands and joints.

(5) The presence of intestinal parasites, such as worms.

(6) Unsatisfactory environmental conditions, as for example, overcrowding and living in ill-ventilated rooms, insufficient sleep and lack of sunshine.

In cases of anæmia there is either an actual diminution of the number of red corpuscles or a deficiency of the amount of hæmoglobin present in the individual corpuscles, but usually both conditions are present. Under these circumstances it will be understood that the oxygen-carrying power of the blood is impaired, and this circumstance explains most of the symptoms. The nutrition of the body cells becomes impaired, including those of the heart, with the result that the circulation becomes poor, and fainting or attacks of giddiness may occur. The patient is usually listless and constipated, and breathlessness on slight exertion is experienced. The reduction in the amount of hæmoglobin in the blood is evidenced by the unusual pallor of the skin, conjunctivæ, lips, and gums.

In the treatment, it is essential to determine and remedy any underlying causes. Adequate rest should be secured to avoid fatigue, and steps must be taken to restore the deficient hæmoglobin content of the blood, which can best be done by the internal administration of an iron salt. In the case of school children, if the home conditions are poor, admission to an open-air school, where good meals and adequate rest can be assured, usually soon cures the condition. Failing such provision, admission to a convalescent home might be arranged.

There is a special form of anæmia termed Chlorosis, which was much more common before girls participated in healthy outdoor games. It occurred almost solely amongst adolescent girls and young women, particularly servant girls whose teeth were neglected, and who seldom went out in the open air, and drank too much tea. The symptoms of this condition are similar to those outlined above: the special characteristics are a marked diminution of hæmoglobin rather than a shortage of corpuscles, and the complexion has a greenish hue.

The most serious of the anæmias is that known as Pernicious Anæmia. This condition, which is extremely rare in children, is considered to be due to failure of the bone marrow to produce new red blood corpuscles. The symptoms of the disease are those already described, but they are more pronounced, distinguishing features being a complete absence of hydrochloric acid in the gastric juice, and the skin often becomes lemon-yellow in colour. The treatment consists in giving carefully regulated doses of stomach and liver extracts.

OPEN-AIR SCHOOLS

The circumstances which led to the modern practice of educating delicate children under open-air conditions are of interest.

Early in the century the Berlin Education Authority was arranging for the transfer of backward children to special "Backward classes." The school doctor when examining the children observed that many of them were anæmic and debilitated, and for these cases strongly recommended open-air treatment, suitable surroundings, careful supervision, good feeding and exercise. As a result the first open-air school was established in 1904 in the pine woods of Charlottenburg.

A few years later six open-air schools for delicate children were opened in London and the provinces, and since that time a large number of authorities have provided similar schools. Although originally these schools were for day scholars only, more recently some residential open-air schools have also been opened, either to deal with the more severe cases, or to cater for children in sparsely populated districts, where the provision of day open-air schools would not be practicable.

The annual cost of maintaining a child in an open-air day school varies between £25 and £35 per annum, and between £60 and £70 in a residential open-air school, as compared with the average cost of approximately £12 for educating a child in a public elementary school.

The *types of cases* for which education under open-air conditions are particularly suitable are :—

(*a*) Children suffering from malnutrition, anæmia, and the after-effects of rickets.

(*b*) Children convalescent from debilitating diseases such as measles, whooping cough, pneumonia, etc.

(*c*) Delicate and nervous children.

(*d*) Mild cases of tuberculous glands in the neck.

(*e*) Cases of chronic bronchial catarrh and quiescent pulmonary tuberculosis.

(*f*) Children suffering from chronic non-contagious external eye diseases such as blepharitis, when associated with malnutrition. Cases of rheumatism and chorea are not suitable for education under open-air conditions.

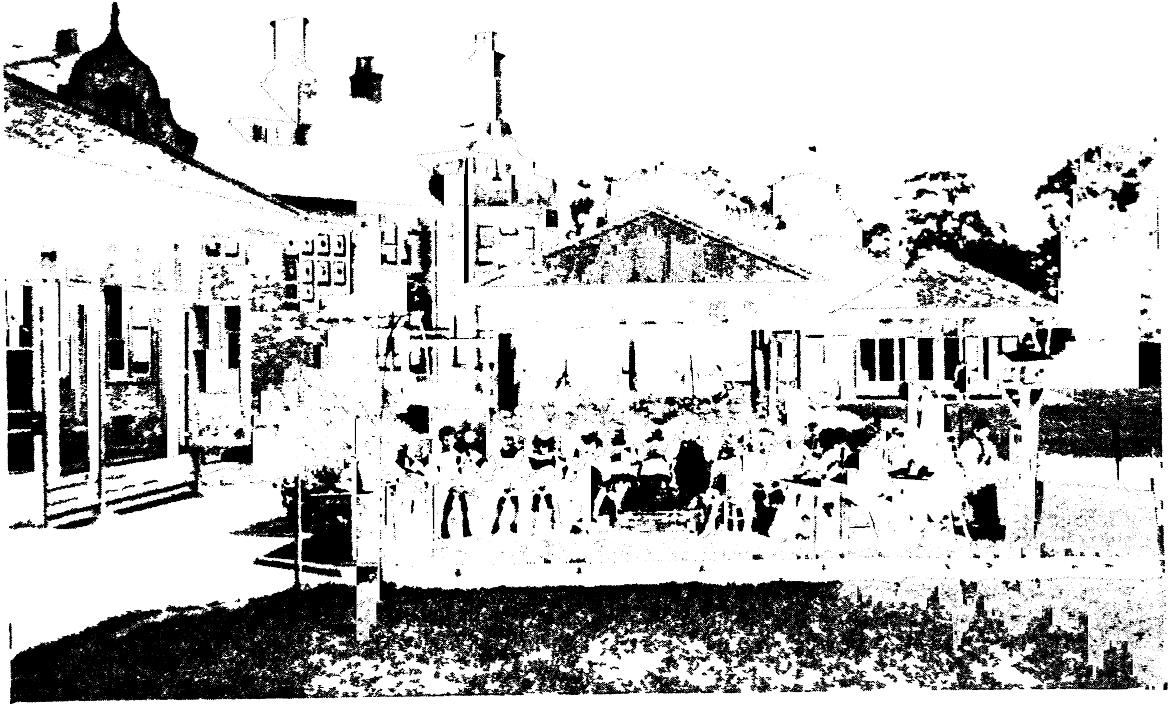


FIG. 56. *A Day Open-Air School, showing Classrooms and part of the Administrative Block.*

The site of the school should be preferably on a slope facing the south, and protected, if possible, on the north and east by trees. It should be of sufficient size to allow of a playing field and garden, and, in the case of a day school, should be located within easy access of a bus or tram route. The accommodation required consists of an administrative block, with dining-room and kitchen, staff room, doctor's and nurse's rooms, etc. ; other buildings required include classrooms, rest sheds, spray baths and offices.

A disused mansion standing in fair-sized grounds can often be utilized for the purpose of an open-air school, the house itself, after alteration, being adapted so as to form the administrative block. As it is important that the classrooms should be capable of being fully opened on three sides, they are usually built as separate units, either as single or dual classrooms on island sites in the grounds.

The paths between the administrative block and the classrooms should be asphalted, and it might be advisable to have a cover over some, or all, of these paths as a protection in bad weather.

Each classroom should have a floor area of at least 400 square feet, and the windows may either be of the Esavian type, or of the French casement type, with pivoted windows over the transoms. To ensure adequate natural lighting in the centre of the classroom, it is an advantage to have the centre portion of the roof glazed.

Provision should be made for warming the classrooms, either by under-floor hot-water pipes, or by hot-water radiators. Although some hold the opinion that heating of these classrooms is not necessary provided the children are adequately clothed, the provision in cold weather of some form of heating, particularly the under-floor type, adds to the comfort of the children.

Relatively more lavatory accommodation should be provided than in the case of the ordinary schools, since the children are at the school all day, and all are required to

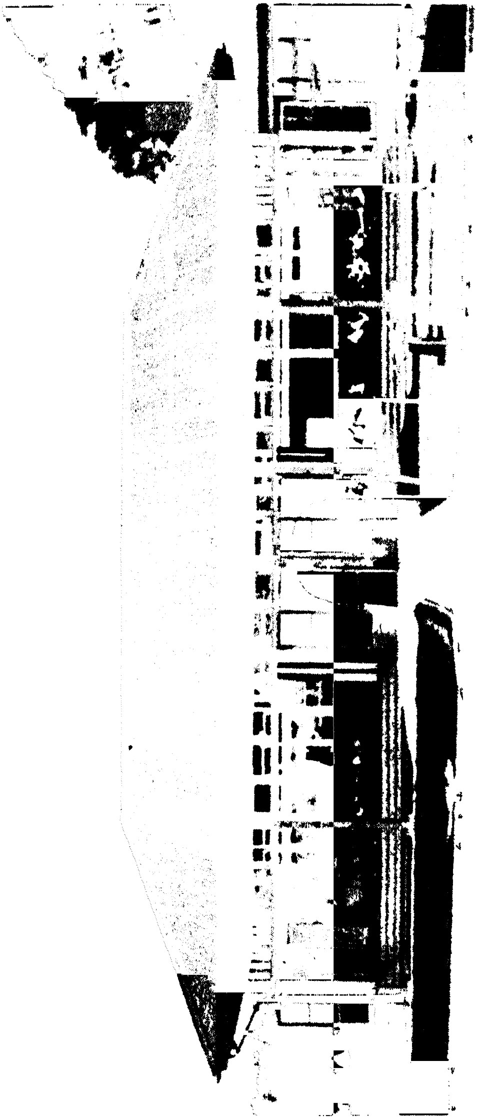


FIG 57. *Twin Open-Air Classrooms.*

wash before each meal. Each child should have a space for its own towel, tooth-brush, and hair-brush.

The installation of spray baths is of considerable value in an open-air school, not only from the point of view of personal hygiene, but also because they provide a useful means of stimulating metabolism. They should be fitted with hot and cold water pipes, and mixing valves for the purpose of adjusting the temperature as required. Two baths a week at least should be given.

As rest constitutes an important part of the daily routine, collapsible rest couches should be provided for all the children. A convenient form is of canvas slung on wooden stretchers or metal tubing, made sufficiently light to enable the children to carry them. A rest shed is necessary for use in wet weather. At least 1½ hours daily should be devoted to the rest period, which need not necessarily be taken by all the children at the same time.

As the underlying principle of open-air education is the increasing of the children's metabolism, that is, the speeding up of all the physiological chemical processes of the body tissues, it follows that in the case of children attending these schools there will be an increased production and dissipation of body heat. Consequently, measures should be taken to see that the increased loss of heat is not too excessive, by ensuring that warm clothing is worn, and that food sufficient both in quality and quantity is given to provide the necessary calories.

As most of the children are malnourished or debilitated, the school meals, which usually include breakfast, dinner and tea, should be so devised as to ensure an adequate supply of first-class protein and fats, deficiency of which has, in many cases, been one of the contributory causes of the children's ill-health. Additional milk and cod liver oil may be given in suitable cases. Arrangements are made for the children to be kept under frequent medical supervision. As soon as possible after their admission the children have their teeth attended to by the school dentist, and in order that the teeth may be maintained in a healthy condition they are subsequently inspected at regular intervals, and treatment given when required.

On the staff there should be a whole time nurse, whose duties comprise the supervision of the personal hygiene and cleanliness of the children, the treatment of minor ailments, assisting the medical officer during his visits, sharing with the teachers the supervision of the children during meals and rest periods, and the weighing of the children fortnightly.

For material benefit to result from open-air education, attendance for at least 12 months is desirable, but many cases may require to remain for two years or longer. For the worst cases a stay at a residential open-air school is preferable, where the children should stay for a minimum of 6 months, arrangements, if possible, being made for their subsequent admission to a day open-air school for a further period prior to their re-admission to the public elementary schools.

Nature study, gardening, various forms of craftwork and outdoor pursuits constitute an important part of the curriculum. Interest in arithmetic may be stimulated by getting the children to measure the areas of their garden plots, or to calculate the cost of feeding any fowls or other animals that may be kept. Produce may be gathered by the children from the vegetable garden, priced by them and the accounts kept.

The following is the description of a typical day's programme at an open-air school :—

The children are conveyed to the school by tram or bus, and arrive there about 8.45 a.m. After arrival, handkerchief drill and breathing exercises are carried out, followed by a shower bath. The school nurse then carries out any medical treatment that may be required. Breakfast is served at 9.30, after which the children are required to brush their teeth. Lessons commence at 10 a.m., being held in an open-air châlet in wet weather, or under the trees or on the lawn in fine weather.

At midday the children, after washing, are given a two-course dinner, after which they again brush their teeth and then rest on the rest couches, either in the rest shed or in the open, according to the weather conditions, for from 1 to 2 hours. Rugs are supplied, which, if necessary, have been previously warmed.

At 2.30 the afternoon lessons are commenced. These are chiefly manual occupation.

At 4.30 tea is given, and, in fine weather this meal may be taken out of doors. After using the tooth-brush again, the children are given an hour or so in which to follow any pursuit they may desire, and after this they return home by tram or bus. In the winter time they return home somewhat earlier.

CHAPTER 18

POSTURAL DEFECTS

Correct posture. Causes and types of malposture. Flat-feet.

NORMAL AND ABNORMAL POSTURES

IN order to be proficient at outdoor games, such as cricket, tennis or golf, it is essential to give attention to the question of balance for the purpose of utilizing the muscles concerned to the best mechanical advantage. Similarly, it is necessary to learn how to utilize to the best advantage the muscles concerned in maintaining a correct posture in order to minimize strain and fatigue. In the position of standing erect and in walking, the head is balanced on the spine and the trunk on the pelvis, the whole of the body weight being transferred through the thighs and legs to the arches of the feet, which form the base. Balance is maintained by the harmonious working together of the opposing muscles controlling the movements of the spine, hips, knees and ankle joints. In the sitting posture, the head and trunk must be evenly balanced and the weight supported evenly on the two pelvic bones, which in this position form the base.

The spine consists of a number of small bones, called vertebræ, between each of which is an elastic cushion of cartilage, called an intervertebral disc, which, though permitting only a limited amount of movement between adjacent vertebræ, allows a considerable amount in the spine as a whole. Viewed from the back the spine is straight, but if viewed from the side it will be seen to have three graceful curves, a forward one in the cervical region, a backward

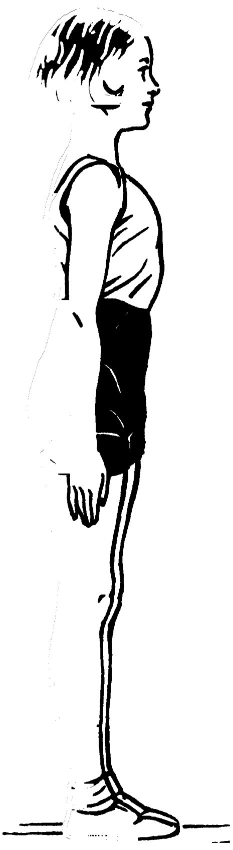


FIG. 58. *Correct Posture.* (*From "Syllabus of Physical Training for Schools, 1933," by permission of the Controller of H.M. Stationery Office.*)

one in the dorsal region, and another forward curve in the lumbar region.

The chief muscles concerned in posture are :—

(*a*) The muscles of the neck which keep the head erect.

(*b*) The powerful spinal and abdominal muscles which, by acting in opposition, steady the spine.

(*c*) The muscles round the hips which steady the pelvis.

(*d*) The muscles of the thigh which control the knee joint.

(*e*) The muscles of the leg, whose tendons support the ankle joint and the arch of the foot.

In a person standing correctly, an imaginary vertical line, termed the "line of direction," passing through the centre of gravity of the body, would, when viewed from the side, appear to pass through the ear, tip of the shoulder, the hollow of the hip, the knee joint and the lower end of the fibula. Neither the chin nor the abdomen should project in front of the line of the sternum, and the shoulder blades should not project as far backwards as the line of the buttocks.

The body cannot be held in the erect attitude except by the co-operative action of opposing muscles, thus, to maintain the spinal curves the spinal and abdominal muscles must work in concert ; similarly, in the case of the knee joint, the muscles at the front and back of the thigh must co-operate in order to keep the legs straight.

The mobile curves of the spinal column are intimately inter-related, so that if one curve is altered balance can be maintained by compensatory curves taking place in another part of the spine. This is effected by means of reflex actions through the nerves supplying the muscles concerned. Thus, if the forward lumbar curve be increased by protruding the abdomen, there is brought about by reflex action a compensating backward increase in the dorsal curve in order that the " line of direction " may be retained within the base of the feet, and the balance thus maintained.

An enquiry regarding postural defects amongst school children, undertaken by Dr. Muriel Bywaters and Dr. Dorothy Ward on behalf of the Medical Officer to the Board of Education, revealed the fact that 75 per cent. of the children examined showed some deviation or other from good posture. They considered that the more important factors contributing to the malpostures discovered were :—

(*a*) Unsatisfactory school conditions, such as insufficient ventilation, poor lighting and unsuitable desks.

(*b*) Poor home conditions, such as overcrowding, lack of sleep, and unsuitable feeding.

(*c*) The absence of adequate physical exercise and practice of hygiene.

(*d*) Disease, such as rickets.

They also found an association between malpostures and bodily and mental fatigue and backwardness.

Apart from malposture, abnormal curvatures of the spine may also be secondary to disease, injury, or defect of the spine, or the bones or joints of the trunk or lower limbs, as for example, a shortening of one leg due to hip disease or infantile paralysis.

The chief abnormal curvatures of the spine are Kyphosis, Lordosis, and Scoliosis.

KYPHOSIS. This is the term applied to an exaggeration of the normal dorsal backward curve of the spine. Postural kyphosis is brought about as a result of muscular fatigue.

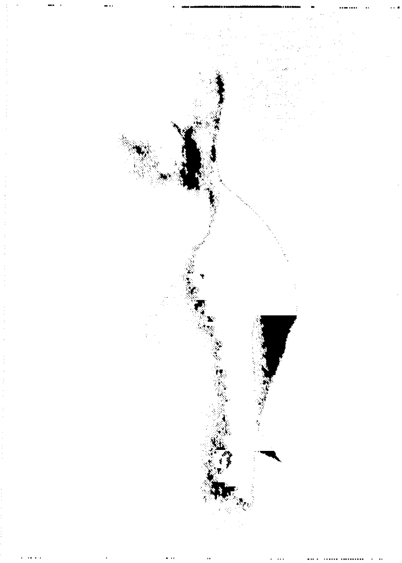


FIG. 59. *Kyphosis with Round Shoulders.*

The balancing of the head and the supporting of the weight of the upper extremities are dependent upon the muscles attached to the upper portion of the spine. If, for any reason, these muscles become fatigued, the shoulders, which are extremely flexible, droop forward and the back and neck bend forward with them. Three different varieties of this postural forward stoop are met with :—

(*a*) Round back, which is a simple exaggeration of the normal dorsal curve.

(*b*) Round shoulders, which is round back associated with a forward displacement of the shoulders.

(*c*) Round hollow back, which is a more severe degree of round shoulders accompanied by a compensatory Lordosis, *i.e.* an exaggerated forward curve in the lumbar region.

In these postural defects, when the head and neck are thrust forward and the spine backward, the breastbone receives less support and flat chest develops, causing defective respiration. The abdomen also tends to protrude, with consequent displacement of the abdominal viscera, and this in turn may be responsible for digestive disturbance and constipation.

The causes of postural kyphosis are those conditions producing ill-health or muscular weakness, such as illness, malnutrition, overcrowding, deficient ventilation, rapid overgrowth and insufficient exercise.

There are also certain predisposing causes, such as sitting at unsuitable school desks which necessitate incorrect posture, uncorrected short sight which leads to excessive flexion of the spine when near work, such as reading, writing or sewing are undertaken. Again, the wearing of clothing supported by suspending straps which bear upon the outer part of the shoulder blades instead of over the root of the neck, tends to pull the shoulders downward and forward.

Apart from the postural variety above described, kyphosis may also be caused by rickets, or tuberculous disease of the spine (Pott's disease).

Treatment of postural kyphosis. The attention of the school medical officer should be drawn to any such cases, and he may recommend certain graduated exercises to be carried out at the school and at home, or refer the cases to the orthopædic clinic. On the other hand, some alteration in environment may be considered necessary, such as education at an open-air school, when malnutrition or debility are the cause.

Such children must be taught how to adopt a correct posture and the incorrect habits of posture which are to be avoided. Teachers should keep them under special observation in school to see that prejudicial postures are not taken up, particularly when they are seated at their desks.

LORDOSIS is the term applied to an excessive forward curve in the lumbar region. In children it is nearly always produced to compensate for the excessive backward curve present in kyphosis cases. It may, however, be an early symptom of tuberculous disease of the spine, or hip disease. Postural lordosis occurs, in a mild degree, in children with poor muscle tone, as in the case of malnourished children.

SCOLIOSIS. This is the name given to any lateral curvature of the spine whether of a temporary or permanent nature. It is due to an inequality of action of the muscles on opposite sides of the spine. The severity of the condition varies much in degree, from a hardly noticeable defect up to one

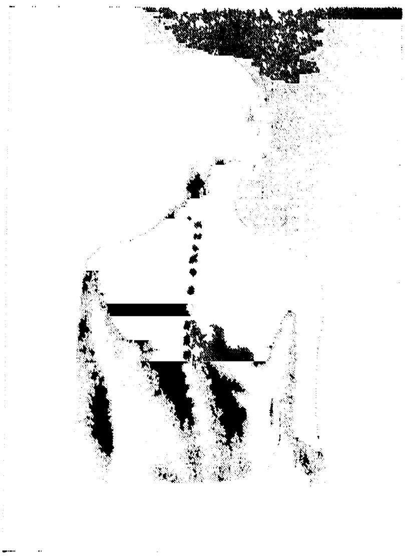


FIG. 60. *A case of Scoliosis.*

in which there is considerable deformity of the spine and chest due to marked structural changes in the vertebræ and ribs which it may occasion.

In the normal child the spine, when looked at from behind, is quite straight, in scoliosis, there is a curve to one side or the other in the dorsal region, with sometimes also another compensatory curve in the opposite direction in the lumbar region. The shoulder and the shoulder blade are raised on the side where the dorsal convex curve is present, and the hip on that side is unduly prominent. In severe cases pain in the back may be complained of, and the child may be noticed to walk with a limp.

Many different causes may be responsible for the condition, the more important of which are rickets, unequal length of the lower limbs through disease of bones or joints, infantile paralysis, and more rarely, congenital dislocation of the hip.

Many children when standing, instead of distributing their weight equally on both feet, throw their weight mainly upon one leg, usually the right, utilizing the other leg as a prop. In this position the spine assumes a C-shaped lateral curve, and unless this habit is checked in time a definite scoliosis may ensue. Girls who are not strong and who frequently carry heavy weights on the same arm, such as a baby or a satchel full of books, are especially liable to develop scoliosis.

School conditions are also sometimes responsible for causing this defect as, for example, when unsuitable desks and seats are provided, or when the lighting of the classroom is poor or comes from the wrong direction.

Cases have also been recorded in which some lateral curvature has been attributable to astigmatism, which has led to a continued tilting of the head and shoulders to one side when reading or writing has been undertaken.

Careful attention to the postures of children when standing, walking and sitting, both at school and at home, may prevent the onset of this condition. The observance of such hygienic measures as the provision of suitable food, adequate ventilation and exercise in the open air are also helpful, and of considerable importance in cases in which the defect has already commenced.

The treatment should aim at improving the general physical condition, the correction of any faulty habits of posture, and the strengthening of the weakened muscles of the back by means of special exercises, which can most satisfactorily be carried out at an orthopædic clinic. In the more severe cases, an operation or the application of some mechanical support may be necessary.

Flat Foot.—The bones of the foot are arranged normally in the form of two arches, an arrangement which not only allows for the transmission of the body weight in the most efficient manner, but also gives spring and elasticity to the step in walking. These arches, one of which is arranged longitudinally and the other transversely, are maintained in position by ligaments between the adjacent bones, and, also, in the case of the longitudinal arch, by the long plantar ligament and two shorter ligaments which run from the os calcis (heel bone) to the metatarsal and tarsal bones respectively. The longitudinal arch is further strengthened by the assistance of the short muscles of the foot and the binding action of the tendons of the deep muscles of the leg which pass

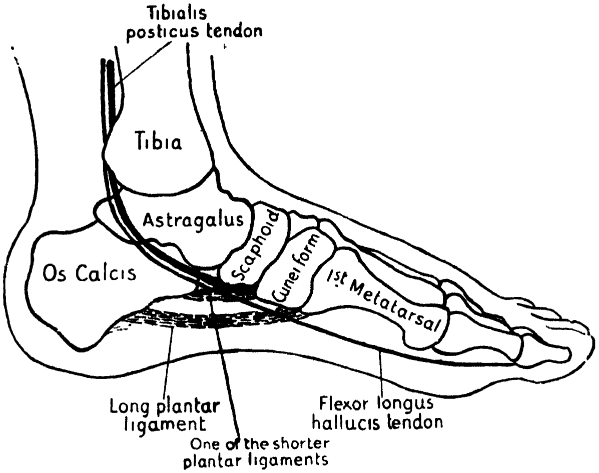


FIG. 61. *Diagrammatic representation of the longitudinal arch of the foot, showing the plantar ligaments and the tendons of the muscles which help to support the arch.*

round the inner side of the ankle to be inserted into certain of the bones comprising the arch.

The transverse arch receives support from the tendon of the Peroneous Longus muscle which passes round the lower end of the fibula and then obliquely across the sole of the foot to be inserted into the base of the metatarsal of the big toe.

When the arches of the feet are well formed, the body weight is so distributed that two-thirds of it is borne by the heels and the other third by the heads of the metatarsal bones. In the standing position, the middle part of the inner side of the sole of the normal foot, on account of the existence of the arches, does not come in contact with the ground. In cases of flat foot, however, the inner side of the foot does come more or less in contact with the ground, according to the severity of the condition, and in such cases, the inner side of the soles and heels of the boots are usually worn down more quickly than the outer sides.

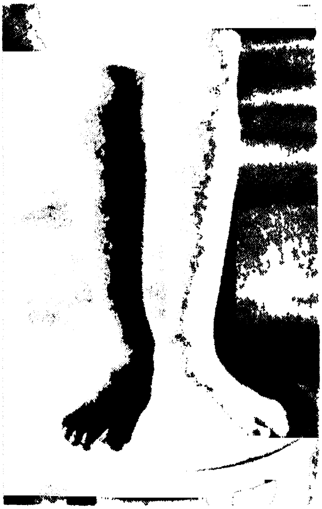


FIG. 62. *A case of Flat Foot.*

Flat foot may occur at any period of life. Occasionally it is congenital, though when it occurs in early childhood it is usually the result of rickets. In adolescence it is generally attributable to an unusually rapid increase in growth, but it may also occur as the result of the softening of the ligaments due to illness.

People engaged in occupations which keep them on their feet for long hours without rest are particularly liable to develop flat foot. Under such conditions too great a strain is placed upon the muscles concerned in supporting the arches, which consequently become fatigued and incapable of doing their work efficiently. Extra strain is thus put upon the ligaments of the foot, which consequently become stretched. This is the sequence of events in the development of adult flat foot, and it will be observed that it is the muscles which give way in the first instance.

Pain, which is often severe, is an early and important sign, and is due to the stretching of the ligaments and pressure on the plantar nerves, caused by the yielding of the arch. Flat-footed people usually walk with their feet well turned out, and there is a noticeable absence of resilience in their gait.

Treatment, which is more likely to be successful if carried out in the early stages, when the deformity is principally due to muscular stretching and the ligaments are only slightly involved, necessitates in the first place, rest for the feet and the avoidance of further foot fatigue. Special exercises designed to strengthen the muscles which keep up the arches of the feet should then be practised. These include standing with the feet turned in and rising on to the toes, and walking on the outer sides of the feet with the feet kept parallel. Such exercises, combined with measures to restore the general health, will suffice in early cases to prevent further deformity and to bring about a cure. In the more severe cases mechanical assistance, such as raising the inner sides of the soles and heels, so as to throw the body weight more on to the outer sides of the feet, will be required.

CHAPTER 19

PHYSICALLY DEFECTIVE CHILDREN

Types and causes of defects. Paralytic conditions. Rickets. Orthopædic schemes. Heart disease. Special education.

THE term physically defective children is usually limited to cases of crippling defects and such other conditions as make it desirable for the children affected to be educated in special schools. The most important of these defects are deformities, which vary in severity from a slight disability to complete helplessness. They arise from a number of different causes, which may be broadly classified into hereditary, congenital, and acquired.

(1) *Hereditary Deformities* are rare, the most important being a disease known as pseudo-hypertrophic muscular paralysis, which is transmitted as a sex-linked Mendelian characteristic, affecting only the male members of the family : the females, who are not affected, transmit it to their sons. In this condition a gradually increasing weakness of certain large groups of muscles occurs along with apparent enlargement of some of these muscles, particularly the calves.

(2) Of the *Congenital Deformities* the following are the commonest : hare-lip, cleft palate, club foot, congenital dislocation of the hip, and cases of spastic paralysis. Less common are complete or partial absence of limbs, accessory fingers or toes, webbed fingers or toes. Most of these conditions can be more or less satisfactorily remedied by operative or orthopædic treatment.

(3) *Acquired Deformities* include the following groups :—

(*a*) Birth injuries, such as the paralysis of certain of the

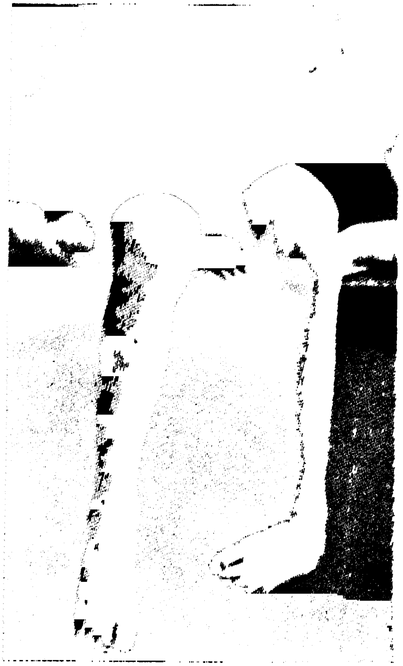


FIG. 63. *Club Foot.*

shoulder muscles as the result of damage, at birth, to their nerve supply.

(*b*) Deformities resulting from various bacterial infections, the most common of these being tuberculosis and acute anterior poliomyelitis. The former often directly affects the bones or joints, and especially the hip, knee, or spine. The latter injures the nerve cells in the anterior horn of the spinal cord, producing the condition known as infantile paralysis, which is a paralysis of the muscles supplied by the nerve cells affected.

(*c*) Those due to vitamin and mineral deficiency in the diet, as in the case of rickets, which may be the cause of bow-legs, knock-knees, or spinal curvature.

(*d*) Deformities resulting from injuries, such as the complete or partial loss of a limb, limitation of movement due to injuries of the joints, or a shortening of a leg following a fracture.

For those concerned with children attending the special schools, it may be of interest to mention that cases of paralysis can roughly be divided into two types, the *flaccid* and the *spastic.* In the former group, the muscles affected are flabby and wasted, and their power of contraction is wholly or partially impaired, due, in the case of infantile paralysis, which is the most common, to injury to the cells of the spinal cord controlling the nutrition of the muscles and their power of contraction.

In the spastic type, on the other hand, the muscles are in a constant state of contraction or rigidity, due to the fact that damage has occurred in the brain, and the impulses from the higher centres controlling the co-ordination of movements have consequently been impaired, with the result that the movements of the affected limb are stiff, awkward, and jerky.

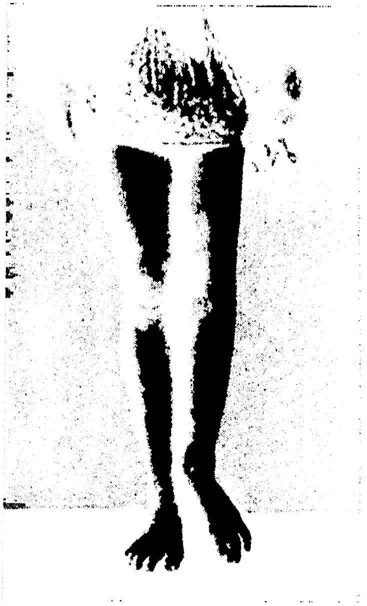


FIG. 64. *Infantile Paralysis of the left leg.*

Different names are given to cases of spastic paralysis according to the various parts of the body affected, all the names ending with " plegia," from a Greek word meaning a stroke or blow. Thus, if only one limb be affected, the condition is called monoplegia, but if both limbs on the same side of the body be effected, the term hemiplegia is used; if both lower limbs and possibly the trunk as well are affected, the term paraplegia is applied, and if all four limbs are affected, the condition is known as diplegia.

Spastic paralysis, as the result of the damage to the brain, has also usually associated with it a certain amount of mental defect, and it often becomes a difficult matter to decide whether any particular case should be educated in a school for physically defective children, or in one for mentally defective children.

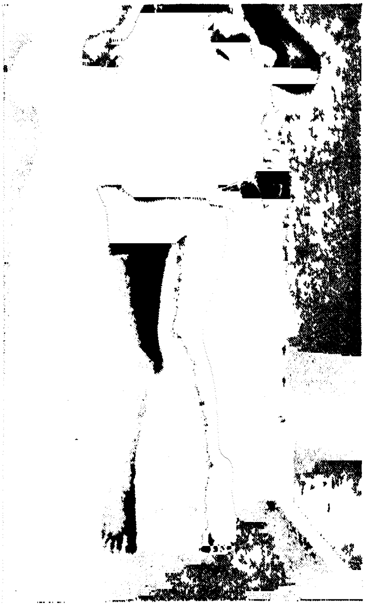


FIG. 65. *Spastic Paralysis of both legs (Paraplegia).*

RICKETS

In recent years, as the result of research, considerable light has been thrown on the cause of this disease, which was formerly responsible for much ill-health and crippling in children. It is now known that rickets develops as the result of an actual deficiency of calcium or phosphorus salts in the food, or an inability of the cells to utilize these salts, owing either to a deficiency of vitamin D in the food, or to a deficient hormone secretion of the parathyroid glands.

Rickets is a disease which is uncommon in tropical countries, owing to the abundance of sunshine present there, the explanation being that the ultra-violet rays of the sunlight act on the ergosterol stored in the skin, and transform it into active vitamin D.

Although the most striking effects of rickets might lead one to imagine that it is mainly a disease of the bones, it is in reality a general nutritional disease affecting almost all the systems of the body, particularly the muscular, alimentary, and respiratory systems, as well as the skeletal system.

The onset usually occurs during the first year of life, the early symptoms being fretfulness, nocturnal restlessness, marked perspiration about the head and neck, and some digestive disturbance. Certain characteristic changes take

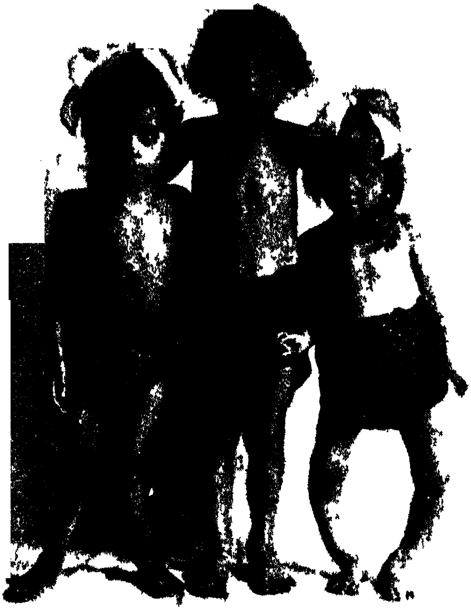


FIG. 66. *Three children six years of age, the centre one being a normal healthy child. The child on the left has knock-knees and the one on the right bow-legs, both deformities being due to Rickets.*

(From "Vitamins A Survey of Present Knowledge" Medical Research Council, 1932, by permission of the Controller of H M Stationery Office)

place in the bones, which are softer than normal, owing to an insufficiency of lime salts, and a thickening occurs in the cartilage at the ends of the long bones where growth is taking place.

The following are the commonest bone changes occurring:—

(*a*) The head is often somewhat square and the normal prominences on the frontal bones unduly enlarged.

(*b*) The chest frequently shows a marked thickening at the junction of the cartilages with the ribs, spoken of as " beading of the ribs." The sternum is often unduly prominent, with a groove on each side, producing the deformity known as "pigeon chest," which is caused by the suction action of the diaphragm pulling on the softened ribs.

(*c*) The spine sometimes develops a kyphosis or a scoliosis, due partly to the lack of tone of the spinal muscles.

(*d*) The pelvic bones are sometimes involved, with a narrowing of the pelvis which, in females, may subsequently seriously interfere with normal child-birth.

(*e*) The limbs, owing to the softening of their bones, are rendered very susceptible to changes in shape owing to pressure, and when the children begin to walk the bones bend, and such deformities as bow-legs or knock-knees develop. Pressure changes are naturally less common in the case of the arms, but they may sometimes occur. Thickening also takes place at the ends of the long bones of the extremities, especially at the wrists and ankles.

As the result of the curvature of the spine and the bending of the long bones of the legs, the child is much smaller in stature than the normal, so much so that some of the cases are practically dwarfs.

Delay occurs in the eruption of the milk teeth, and when they erupt they are apt to decay easily, whilst the permanent teeth are badly formed and are deficient in enamel and very liable to decay.

The muscles are almost always flabby and poorly developed and the ligaments become relaxed, thus permitting considerably increased movements at the various joints. This greater flexibility of the joints is a contributory factor in the causation of knock-knees and bow-legs.

A noticeable feature of this disease is the prominent abdomen (pot-belly), which is caused by the flatulent distension of the intestines and lack of tone of the abdominal muscles. Bronchitis and other respiratory diseases are common, and often dangerous owing to the weak condition of the chest walls.

Rickets is much more common amongst artificially-fed than breast-fed children, and when it does occur in the latter it is due to a deficiency of salts and vitamin D in the mother's milk, and it is therefore important that the mother's diet should contain an adequate supply of these substances. As there is a risk of the cow's milk being deficient in vitamins, particularly in the winter months, it is a wise precaution to give bottle-fed infants a daily dose of cod liver oil, or some irradiated ergosterol, which is now commercially manufactured. The importance of fresh air and sunshine in the prevention and treatment of rickets cannot be over-emphasized. On account of the smoke and clouds, particularly in industrial areas, which often cut off the sun's ultra-violet rays, the body is not always able to produce sufficient vitamin D from the irradiation of the ergosterol normally present in the skin. Fortunately, scientists have discovered that both the mercury vapour lamp and the carbon-arc lamp give out ultra-violet rays which have the same beneficial effect on the skin as the ultra-violet rays of sunlight, and considerable use is now being made of this method of treatment in hospitals, infant welfare centres and school clinics. Other valuable remedies for the treatment of rickets are cod liver oil, irradiated ergosterol, milk, fresh butter and eggs.

The following help to reduce the incidence of this disease : the establishment of ante-natal infant welfare centres, day nurseries, nursery schools, the demolition of slum property, the erection of sanitary dwellings, and the provision of open spaces and parks. In the past many of the children requiring education in the special schools for the physically defective had been crippled by rickets, but, by using the preventive measures outlined, the incidence and severity of the disease has been much reduced, and it can be reasonably hoped that in the near future the disease will be regarded as a rarity.

ORTHOPÆDIC SCHEMES

In addition to the provision of special schools for children already crippled, most local education authorities have organized orthopædic schemes in an endeavour to prevent or mitigate crippling deformities.

Since most of the crippling conditions of childhood are either congenital in origin or commence during the first few years of life, as, for example, rickets, infantile paralysis, and tuberculosis of the bones and joints, it is of the utmost importance that all schemes for the prevention of crippling should also make provision for dealing with children under school age, for whom the local health authority and not the education authority is responsible.

In practice it is convenient for these two authorities to combine in providing a joint scheme, on the following basis :—

(1) Arrangements should be made for the early discovery of the cases.

Such information is usually obtained through the medical officers and nurses of the infant welfare and school medical services, general practitioners, tuberculosis officers, teachers, school attendance officers and social workers.

(2) Facilities should be provided for in-patient treatment at suitable hospitals.

In-patient treatment can be secured at a general hospital or a children's hospital, but in some areas special orthopædic hospitals have been built, usually in the country or at the seaside.

(3) One or more orthopædic clinics should be established to which children can be summoned for periodical inspection by the surgeon, and at which massage and remedial exercises can be given, and the suitability and condition of the splints and apparatus supervised.

One or more part-time surgeons are necessary to take charge of the work at the clinics, whilst one or more orthopædic nurses are required to supervise the carrying out of any remedial exercises, massage, etc., recommended by the surgeon.

FIG. 67. *Remedial exercises at an Orthopædic Clinic.*

(4) Arrangements must be made for supplying any surgical appliances or apparatus required.

The various types of apparatus, such as special jackets for spinal deformities, or special splints or boots in cases of paralysis of the legs, are often expensive, and arrangements have to be made to assist poor parents to secure the necessary appliances.

(5) A system of following up to ensure regular attendance at the clinics and to impress on the parents the importance of continuous and regular treatment should be established, for only in this way can the best results be obtained.

(6) Vocational training for the more serious cases should be provided.

A certain proportion of the cases coming within an orthopædic scheme will, despite treatment, always be left with a considerable amount of crippling defect or disability. In order to give such cases the best chance of being self-supporting in after-life, it is very important that they should be given such vocational training as is best suited to their particular incapacity. Such training may be commenced at the special schools and later continued at special workshops for cripples. When these cripples are fully trained, efforts should be made to find them suitable employment.

HEART DISEASE

DISEASES or disorders of the heart are not infrequently met amongst school children, but they vary very considerably in the disability which they cause. There are three main types—congenital, acquired, and the so-called functional.

In cases of *congenital* heart disease, the most common defects with which the children are born, are either a narrowing of the opening from the right ventricle into the pulmonary artery, or a defective dividing wall between the right and left ventricles, with the result that the blood in the two ventricles mixes to a greater or less extent, depending upon the size of the hole in the septum. In some instances there is a marked blueness of the skin, particularly of the face and lips, which makes the cases easily recognizable.

Acquired heart disease is a much more frequent type, and in the majority of cases is the result of rheumatic infection of certain valves of the heart, most often the mitral valve, or of the heart muscle, but more usually both are affected. The affected valves are rendered inadequate to perform their duties properly, and an increased strain is therefore put upon the heart which, being thereby weakened, usually dilates. By suitable, and usually prolonged treatment, an acute attack may make a more or less complete recovery, but many cases do not completely recover, and they are left with a chronic heart affection. Fortunately the heart possesses a certain amount of reserve power, known as compensation, and in the milder cases, when the heart is fully compensated, the child can lead a more or less normal life. But in the more severe cases, even though the heart be compensated, much more care has to be taken, and such children should be educated at special schools, where their physical activities can be suitably regulated, and periodic rest periods arranged if and when required.

An important sign which would lead one to suspect that compensation is breaking down is shortness of breath on slight exertion, and if there is any swelling of the legs or ankles it may be definitely taken that compensation has broken down, and the child is in need of medical treatment. Although rheumatism is the outstanding causal factor of acquired heart disease, this condition may also follow an attack of diphtheria or scarlet fever, and, more rarely, other infections.

The term *functional* heart disease is applied to those conditions, such as rapidity, slowing or irregularity of the heart beats, or palpitation, when not associated with any structural defect. These conditions alone are not serious, and often recover spontaneously.

SCHOOLS FOR PHYSICALLY DEFECTIVE CHILDREN

THE Education Act, 1921, imposes upon local education authorities the duty of determining which children in their areas are physically defective. Such children are defined as " children who, by reason of physical defect, are incapable of receiving proper benefit from the instruction in the ordinary public elementary schools, but are not incapable by reason of that defect of receiving benefit from instruction in such special classes or schools, as under this part of this Act may be provided for defective children."

It is also the duty of every local authority to make special educational provision for such children.

Before admission to such special classes or schools, it is required that the children be certified by a duly qualified medical practitioner approved by the Board of Education. The certifying officer attending the special schools is required to review each case at least annually, with the object of determining whether the child is fit to be transferred to a public elementary school.

When power was first given to local authorities at the close of the last century to provide special schools, the types of children for whom such provision was intended comprised those suffering from crippling defects, heart disease, etc. But of recent years there have also been included under the definition of physically defective, delicate children, such as cases of debility, anæmia, malnutrition, chronic bronchitis, etc. The addition of this group has led to the provision of a new type of special school, namely the open-air school, either day or residential.

It is usually found that the largest number of cases of crippled children admitted to the special schools are those suffering from the after-effects of tuberculosis of the hip, spine, knee, etc. ; next in order are cases of paralysis (chiefly infantile paralysis), heart disease, deformities due to congenital causes or to rickets, and disabilities resulting from injuries.

The compulsory attendance of the children at the special schools can be enforced from the age of 7, and they can be retained, if necessary, until the age of 16. Children of the ages of 5 and 6, however, may also be admitted if the parents be willing. Arrangements are made, where necessary, for the transport of the children to and from the schools by tram, ambulance, or other conveyance.

The school should be a one-storied building with well-lighted classrooms, which provide at least 18 square feet of floor space per child. Single desks or tables with chairs should be provided, and also some rest couches for heart cases and others for whom rest periods are recommended. Spray baths or other bathing facilities should also be provided. Special rooms should be equipped for various forms of manual instruction, such as woodwork, tailoring, shoemaking and repairing, bent-iron work for boys, and cookery and laundry work for girls. As the children have their mid-day meal at school a dining-room is necessary, and this room can also be used as an assembly hall and for other purposes, such as physical exercises or games.

Arrangements are made for medical officers to attend more frequently at these schools than at the public elementary schools, and it is usual for a whole-time nurse to be appointed on the staff for the purpose of attending to any dressings required, to keep under regular supervision splints or other apparatus worn by the children, and to report any defects in such apparatus, in order that they may be repaired without delay. She should be responsible also for supervising the personal cleanliness of the children, and for superintending the children during rest periods.

As many of these children have previously missed a considerable amount of schooling through illness they are often educationally backward, but as the classes in the special schools are limited to 25 in average attendance, the children are able to receive more individual attention than would be the case if they attended an ordinary school.

Owing to the difficulty which crippled children are likely to experience in securing suitable occupations on leaving school, the importance of making arrangements for their vocational training during their last few years of school life will be appreciated. In Liverpool, a special officer attached to the Juvenile Employment Department has been appointed to assist the children attending all the various types of special schools or classes to secure suitable employment on leaving school.

It is the usual practice for After-Care Committees to be established in connection with these schools for the purpose of furthering the interests of ex-scholars until the age of 21.

CHAPTER 20

OTHER COMMON AILMENTS

Tonsils and Adenoids. Fatigue. Speech defects. Word-blindness. Word-deafness. Headache. Vomiting. Enuresis. Epilepsy. Bronchitis.

TONSILS AND ADENOIDS

SURROUNDING the nasopharynx there is a more or less complete ring of lymphoid tissue, similar in structure to that of the lymphatic glands, the function of which is probably to act as a first line of defence in protecting the body from attack by bacteria, which are constantly present in the nasal and oral cavities. This lymphoid tissue is concentrated in three positions, one part, known as adenoids, being situated in the roof and back wall of the nasopharynx, and the other two concentrations, known as the tonsils, being located at the back of the mouth, one on each side.

The adenoids have a corrugated appearance, due to their arrangement in a series of ridges separated by intervening grooves, whilst in the case of tonsils there are a number of small pit-like depressions, known as crypts. By these arrangements the superficial area of the adenoids and tonsils is increased, and the grooves or crypts act as traps for invading organisms, in which they can subsequently be dealt with by the phagocytes present in the lymphoid tissue. It has been suggested that the function of adenoids and tonsils may be to act as a means of creating antibodies, which pass into the general blood stream to aid the rest of the body in resisting bacterial infection.

It is essential that the tonsillar crypts should empty themselves from time to time, and this is normally achieved by their compression as the result of the contraction of the muscular walls of the pharynx. If through any cause, the crypts become blocked, inflammatory processes are apt to be set up.

Enlargement of the tonsils or the adenoids, or both, is fairly common amongst children, but such enlargement tends automatically to diminish towards the age of puberty. Adenoid enlargement usually commences during infancy, consequent upon a series of attacks of nasopharyngeal catarrh, such as colds, and following certain infectious diseases, particularly measles, as a result of which a chronic rhinitis (inflammation of the mucous membrane of the nose) occurs, and this condition is probably responsible for the adenoid enlargement. There appears to be also some association between the presence of septic teeth and the existence of unhealthy tonsils and adenoids.

As a result of repeated infections, the lymphoid tissue enlarges in response to the increased work which it has been called upon to undertake.

It is highly probable that unsatisfactory environmental conditions, such as overcrowding, overheated or ill-ventilated bedrooms or nurseries, and lack of fresh air and sunlight, are contributory causes by lowering the resistance of the body.

The signs and symptoms caused by adenoid growths may be divided roughly into those due to obstruction, and those due to infective processes. The obstructive symptoms include mouth breathing, snoring during sleep, and alteration in the tone of the voice owing to the difficulty in pronouncing the nasal sounds m, n, and ng. Thus, for example, the words nose, money, ring are pronounced like doze, buddy, and rig. Deafness may occur when the adenoid enlargement blocks the opening of the Eustachian tubes and so prevents air from entering the middle ear to equalize the pressure on both sides of the ear-drum.

Infection of the mucous membrane of the naso-pharynx may spread up the Eustachian tubes and so infect the middle ear, leading to suppuration and a discharge from the ear.

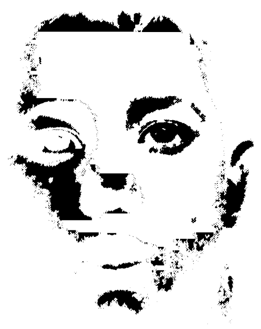


FIG. 68. *Adenoid Facies.*

(From "The Clinical Study and Treatment of Sick Children," by John Thomson and Leonard Findlay, by permission of Messrs Oliver & Boyd, Ltd)

The facial appearance of a case of adenoids is more or less characteristic, the bridge of the nose being often flattened, the nostrils narrow, the palate highly arched and the front teeth prominent, and the mouth is kept open, causing a vacant expression. As a result of the obstructed air entry through the nose, the lungs do not expand properly and the chest wall is flattened, and in these cases the children often suffer from recurrent bronchial catarrh.

Mentally, these children are often slow in response, listless, lack power of concentration and are consequently backward at school, all these symptoms being aggravated when deafness is also present.

Enlargement of the tonsils is, in the majority of cases, also associated with adenoid enlargement and is then attributable to the same causes. When not so associated, it may be the result of repeated attacks of acute tonsillitis, or a sequel of scarlet fever.

The signs which usually draw attention to the condition are mouth breathing, thick speech, a history of frequent sore throat, and enlarged glands in the neck.

In some cases tonsillar enlargement may give rise to no special symptoms, and may only be brought to light when the school medical officers carry out the routine medical inspections of the scholars.

Of recent years there has been a tendency to attribute an ever-increasing number of ailments to affections of the tonsils, such as coughs, colds, bronchitis, asthma, incontinence of urine, rheumatism, or general ill-health. No doubt there are occasions when the tonsils are responsible, but there are many other possible causes which can produce these conditions, and until research has thrown more light on the subject of the tonsils, both in health and disease, they must not be too hastily condemned for removal by operation.

Removal of the tonsils or adenoids does not always automatically cure the child of the habit of mouth breathing, and special breathing exercises have often to be carried out subsequently in order to help to form the habit of breathing through the nose. The other symptoms usually improve rapidly after operation.

FATIGUE

FATIGUE may be defined as a weariness of mind or body, associated with a diminution of working capacity. Investigation of this subject has been undertaken both psychologically and in the physiological laboratory, where it has been ascertained that in fatigue due to physical exertion the central nervous system is affected before the muscle tissues, although the sensation of fatigue is, from the first, felt only in the muscles.

It is considered to be due to the toxins, resulting from metabolism, entering the blood at a greater rate than they can be eliminated. The yawning of a fatigued person is caused by acid poisons combining with the sodium bicarbonate in the blood and thus increasing the amount of carbon dioxide present. This has the effect of stimulating the respiratory centre in the brain, and so causing those slow, deep inspirations and expirations of the lungs which are characteristic of yawning.

These fatigue-producing toxins of metabolism act upon the nervous system in a similar manner to alcohol, that is, by decreasing the power of conductivity across the synapses of the nervous system, the higher centres of the brain being the first to be affected. The action of tea and coffee in apparently counteracting the symptoms of fatigue is due to their active principles, thein and caffein respectively, which have the effect of reopening the synaptic bridges.

Cannon has studied the phenomenon known as the development of " second wind," that is, the sudden feeling of relief from great exhaustion experienced by athletes during a period of strenuous exertion. He states that the emotional stress causes the sympathetic nervous system to stimulate the suprarenal glands to increase the supply of their internal secretion to the blood stream. As a consequence the exhausted heart is caused to beat more strongly, and so improves the circulation of the blood which thus becomes more rapidly oxygenated. The liver also is stimulated to convert some of its store of glycogen back into sugar, to nourish the rapidly fatiguing muscles.

Of more practical concern, however, is the study of those instances of fatigue of less severe degree which result in a gradually diminishing output. The efficiency of the heart and respiratory apparatus is at its maximum for some three or four hours after breakfast, and gradually declines during the day, though there is a slight recovery after each meal. It has been discovered that, if efficiency is to be maintained, there must be established a definite relationship between the periods of work and intervals for rest.

The correct spacing of the periods of work and rest is of considerable importance, and the judicious introduction of short periods of rest, as has been demonstrated by experiments in factories, not only obviates monotony but often actually results in increased output, even by as much as

10 per cent., despite the actual diminution in the total period of time worked.

In everyday life efficient individuals automatically find out for themselves the most advantageous way of adjusting their working time into periods of work and intervals of rest, in order to achieve the maximum output with the minimum of fatigue.

Personal feelings and desires must also be considered in relation to fatigue, and the question of monotony is of importance. Individuals differ very materially in regard to their physical and mental aptitudes One, who is quite happy undertaking monotonous work which would bring about mental depression in another worker, might find more responsible work too great a mental strain. The correct placing of individuals into vocations most suited to their abilities and temperaments is therefore of considerable importance both for employees and employers.

In the study of the question of fatigue in industry, statistical methods based on the results of observation of such factors as output, proportion of spoilt work, amount of time lost for alleged sickness, the number of accidents occurring, etc., have been largely used, and the problem of how best to maintain efficiency and obviate undue mental fatigue amongst school children can be studied in a similar manner. By making careful observations of the amount and quality of their output, the development of inaccuracies in their work, and the degree of attention maintained, the best length and the most suitable order of the different lessons can be determined for children of each age.

The following signs are suggestive of fatigue in the case of school children :—

(1) Diminished attention, lack of interest, inability to concentrate, a temporary weakening of the memory, a falling off in the quality of the work, and apparent dullness.

(2) Yawning may occur, whilst drowsiness and a tendency to fall asleep are evidence of a great degree of fatigue.

(3) General relaxation of the muscular system, as is evidenced by a lack of tone in the muscles which give expression to the face, causing the child to look tired, particularly below the eyes, where puffiness may occur. The head and body may also droop forward as a result of the relaxation of the muscles of the neck and spine. One test for muscular fatigue is to get the child to hold out the arms straight out in front with the palms downwards, and it will be noted that the hands and particularly the thumbs tend to droop.

The conditions necessary for preventing undue fatigue in the case of school children are, firstly, all those factors necessary for the maintenance of general health, such as an adequate and well-balanced diet, the efficient functioning of all the organs of secretion and excretion, a sufficiency of exercise and rest, whilst an adequate amount of sleep is of particular importance. Secondly, the school time-table should be so arranged as to minimize boredom, the length of the lessons being arranged in accordance with the ages and mental capacities of the children concerned.

Intellectual lessons, generally speaking, should be of shorter duration than practical lessons, and should be taken as far as possible in the mornings, whilst succeeding lessons should be as dissimilar in type as possible, the aim being so to arrange the various lessons as to utilize different intellectual centres in turn. Suitably spaced intervals for recreation provide a relief from brain exercise.

The environmental conditions under which school work is carried out is also of considerable importance in bringing about fatigue. The most important of these factors are the ventilation, temperature, and humidity of the atmosphere, and the methods and efficiency of the heating and lighting arrangements. Bad illumination affects both the quality and quantity of the pupils' output, increases nervous strain and has a depressing effect, whilst unsuitable seats and desks predispose to fatigue.

As fatigued children can receive little benefit from their lessons, it is important that the teachers should keep a constant look-out for evidences of fatigue in the children under their care. If several of the children in a class appear fatigued the teacher should suspect that there may be something wrong with the school conditions, such as over-heated or insufficiently ventilated classrooms, inadequate lighting, unsuitable desks and seats for the children concerned, or a too long or uninteresting lesson.

The teacher should draw the attention of the school medical officer to individual cases of fatigue, and he will examine the physical condition, particularly the nutrition, sight and hearing, and make enquiries with regard to hours of sleep, recent illnesses and home conditions, including the possibility of too much domestic work or home lessons. The medical officer would then be in a position to recommend any special remedial measures which may be necessary.

SPEECH DEFECTS

THE mechanism of voice production is a complicated one, and is brought about by rapid modification of the sound waves, when air is expelled from the lungs past the vocal cords, which are caused to vibrate. The sounds originating in the larynx can be altered in pitch by varying the tension and shape of the cords and by varying the pressure of the air expelled. It can also be modulated by various movements of the lips, tongue, and palate to produce the sounds, which, in combination, are employed for the purpose of speech. True speech cannot be said to have been acquired until the child can repeat intelligently words which he has heard and is able to apply them more or less correctly, which usually occurs at the age of nine months or upwards. It will be seen, therefore, that the centre for speech in the brain is very closely associated with the hearing centre.

For proper speech production the following requirements are necessary:—

(1) Perfect co-ordination between the muscles of the

chest and the abdomen and those of the larynx and mouth, there being a very elaborate controlling mechanism in the brain for speech production.

Words are utilized in normal speech as symbols to express thought, which is a methodical assembling of appropriate knowledge and judgments, formed as the result of previous experiences which have been registered and stored away in the intellectual areas of the brain. Any psychological shock may upset the controlling mechanism of the brain which co-ordinates the muscles concerned in speech, and this is, in the majority of instances, probably the cause of stammering.

(2) Normal anatomical conditions of the larynx and nasopharynx, palate, tongue, teeth and lips.

Such abnormal conditions as hare-lip, missing front teeth, cleft palate, enlarged tonsils and adenoids, considerably affect the quality of speech.

Stammering is a functional speech defect resulting from failure of co-ordination of the various mechanisms concerned with speech, and is much more common amongst boys than girls, the ratio being about five to one. There are two types, one an " initial stammer " in which there is a difficulty in commencing to say the first consonant or syllable of a word, due in some cases to a spasm of the muscles concerned, and the other, a " repetition stammer " in which there is a reiteration of the consonant sound at the beginning or middle of a word, these latter varieties being sometimes referred to as " stuttering."

In a child of a nervous temperament any unusual emotional strain, such as a fright, worry or anxiety, or the effect of impaired general health or illness, may be a sufficient predisposing cause to initiate a stammer. In some cases it may be the result of a wholly or partially repressed memory of some painful incident in earlier life.

There is no doubt that a considerable number of cases occur as the result of imitation of another stammerer, and when more than one case occurs in a family, as is not infrequently the case, imitation is probably the explanation rather than the influence of heredity.

Both rheumatism and rickets affect the stability of the nervous system and are sometimes the causes of stammering. Occasionally the attempt to make a left-handed child, who is temperamentally neurotic, substitute the use of the right hand for the left, may result in the child commencing to stammer.

Dr. Boome and Miss Richardson in their book have pointed out that there are three critical ages of onset, namely, the ages of two, five and seven, and draw attention to the fact that these are the ages of commencing to talk, entry to school and commencement of the second dentition, and the transference to a higher school department respectively.

The treatment of stammering should only be undertaken by specially trained teachers. The employment of trick methods, such as tapping with the foot or fingers, should not be adopted, as these methods, though they may lead to a temporary improvement, almost invariably result ultimately in making the condition worse.

Some of the larger education authorities have established classes for stammering, and these classes are taught by teachers who have specialized in the treatment of the defect. Briefly, the line of treatment adopted is, firstly, to have the child examined by one of the school doctors in order that steps may be taken to have any physical defects remedied, particularly defects of hearing or vision which may aggravate the condition. The environmental circumstances and past history are enquired into and an endeavour made to ascertain the determining cause, which may be some real or imaginary fear. In this connection co-operation with the psychologist at a child guidance clinic would probably be of valuable assistance. In the class, at which the children may attend twice weekly or more frequently, the child is given exercises to help in relaxing the mental strain. By the constant practice of feeling at muscular and mental ease, such feeling gradually becomes a habit.

By keeping in touch, and co-operating with the teacher of the stammerer's class, much can be done by the class teacher in assisting these handicapped children towards their cure. Whilst under treatment, reading aloud and all oral work at school should be excused, unless the child is a good reader, as continuing to stammer at lessons may interfere with the success of the treatment. The child should be told that he need not speak at all unless he feels that he can do so fluently without any effort. As the stammer improves, some gradually increasing responsibilities may be given which will assist in establishing confidence.

In addition to stammering there are certain other speech defects amongst children of which the following are the more important :—

(1) *Lisping* is the term applied to the defective enunciation of certain sounds, particularly S, owing to the tongue being placed in the wrong position for the particular letters lisped, *e.g.* " yeth " for " yes." Sometimes this is due to some of the front teeth being absent or misplaced, or abnormal shape of the jaws not allowing the front teeth to meet properly. A certain number of young children who have no physical defects of the mouth pass through a stage of lisping, but by the time they leave the infants' department the habit has usually been corrected.

(2) *Lalling* is " baby speech " used by a child who should have outgrown such speech. It is characterized by the substitution of one consonant for another, the dropping of a final consonant, or the omission of middle ones, such as " vewy dood " for " very good," " yaining " for " raining " and " likkle " for " little." Such speech is not infrequently met with in mentally defective children.

(3) *Idioglossia* is a kind of wholesale persistence of baby talk in which the vowels remain, but the consonants are either altered, substituted or elided. The defect is so

pronounced as to make the child's speech almost unintelligible, and to give the impression that the child has evolved a language of its own. Thus " father " may be pronounced as " tahee " or " little " pronounced as " ick."

The cause of this condition is not definitely known, but it has been suggested that it may be due to some auditory defect, in which the child is unable to discriminate differences in certain sounds.

(4) *Echo-lalia* is the parrot-like repetition of words heard without any appreciation of their meaning, *e.g.* if someone says to a child suffering from this defect " what is your name ? " the child merely replies " name."

WORD BLINDNESS

To a child who has not learnt his letters, the written or printed letters of the alphabet convey no more meaning than the written symbols of the Hebrew, Arabic or Chinese languages convey to the average adult. In learning to read, it is first of all necessary to recognize visually the various letters, and to be able by the organs of speech to reproduce audibly the sounds which the symbols represent. With practice the stages of recognizing two, three or more lettered words as a whole are gradually gone through, with a correspondingly increasing facility for pronouncing the words for which the letter symbols stand.

In congenital word blindness the child, whose sight may be perfect, is unable to understand printed or written words. It is probably due to a failure of co-ordination between the visual centre in the brain and those other centres whose duties are to interpret the meaning of the visual impressions received as the result of looking at the symbols.

Whilst cases vary in their severity, the difficulty common to all, however, is that of interpreting as a whole, letters in combination, and, for this reason also, they more easily recognize Arabic numerals, such as 8, rather than the Roman symbol viii.

Children suffering from this defect are usually of average or even above average intelligence. When children whose attainments in other subjects are equal to the average for their age, but whose reading is very bad, the possibility of this defect must not be overlooked.

Dr. Thomas estimated that amongst the schoolboys in London, about 1 in every 2,000 was affected with this condition.

Dr. Kerr quotes an interesting case of the son of an English colonel, whom three tutors failed to teach to read, and who in despair ran away from home and started work at the bottom of the ladder in an engineering shop. He rapidly rose to the position of a consulting authority, being able to do all the necessary calculations, and work out the most complicated drawings of marine engines, but needing some-one else to letter the drawings, since he was completely letter blind.

With regard to treatment, it is fortunate that in many of these cases the auditory centre in the brain is well developed, and advantage should be taken of this by paying special attention to the education of this centre in order to supplement the defective centre.

The muscular and tactile senses may also be made use of in the worst cases, where difficulty is experienced in teaching the child to appreciate by sight even the meaning of individual letters. The interpretation of the letters may be learnt by tracing them in mid-air with the fingers, by feeling block letters or letters cut out of sandpaper, or by means of pencil and paper.

It is also useful to get these children to spell the words out loud, letter by letter, and thus train the auditory and visual centres at the same time. In attempting to teach them to read, the lessons, which should be given daily, ought to be of several short spells, as such children rapidly develop cerebral exhaustion from the effort, and are then quite confused.

WORD DEAFNESS

THIS is a congenital condition in which the child, though able to hear sounds, cannot attach any significance to spoken words or musical sounds, or distinguish between different sounds.

Word deafness is fortunately much rarer than word blindness, probably because the brain centre responsible for understanding speech is older in the history of the development of the brain, and consequently more stable than the centre for interpreting the written or printed word.

Word deaf children usually develop an unintelligible language of their own (*idioglossia*). On account of the great difficulty in educating them they have sometimes been mistaken for imbeciles, but as a rule, their general intelligence is quite equal to that of the normal child. In these cases the visual centre should be specially trained to reinforce the defective centre, and this can be done by teaching the child to lip-read.

HEADACHE

HEADACHE is not really a disease but a symptom, which, in children particularly, should not be ignored, since it may indicate the onset of some serious disease, or be caused by some condition which, if treated at once, can be easily remedied. It may be produced by one or more of many different causes, the following being the most important :—

(*a*) Eye strain, due to fatigue of the ciliary muscle, resulting from incorrected errors of refraction, especially astigmatism or hypermetropia, or to unsuitable glasses ; the use of the eyes for too much near work or too fine work, or again to the irregular wearing of glasses. Headaches may also be caused by excessive glare reflected from the blackboard or the pages of the books, lighting from the front of a classroom, or by too intense artificial lighting which is not properly diffused by reflecting bowls. In headache associated with eyestrain the headache is usually over the front part of the head.

(*b*) Acute or chronic illnesses may be responsible. The onsets of various acute illnesses are frequently accompanied by headache, as for example, bronchitis, pneumonia, meningitis, and infectious diseases, especially influenza. In the cases of chronic illness, headaches may result from toxin absorption from septic teeth, diseased tonsils or adenoids, or unhealthy conditions of the alimentary tract, such as constipation.

(*c*) Fatigue due to mental overwork, insufficient sleep, or being in badly-ventilated rooms.

(*d*) Children suffering from anæmia, rheumatism, or chorea are very liable to have headaches from time to time.

(*e*) A particular type of headache to which children and adults are prone occurs in a condition known as migraine, in which the headache is usually confined to one side of the head. This condition is sometimes referred to as sick headache, as it is usually accompanied by vomiting.

VOMITING

VOMITING is brought about by a contraction of the diaphragm and the muscles of the stomach and abdomen, these being controlled by a centre for vomiting in the brain which can be stimulated by psychological causes, such as disgusting sights and smells.

There are many conditions which may cause vomiting in children of school age, some of which are of serious import, such as the onset of many of the acute infections, *e.g.* pneumonia, scarlet fever, and influenza, appendicitis and other acute abdominal conditions, and more rarely kidney disease, meningitis, and the ingestion of poisonous substances.

Of the less serious causes the commonest are indiscretions of diet, such as overeating, or the eating of food to which the children are not accustomed. In certain children there occurs from time to time an interference with the digestion or absorption of carbohydrates, in consequence of which an undue metabolism of the body fats occurs, resulting in an excessive production of certain fatty acids. In this condition, which is known as *acidosis*, the vomiting is often severe and prolonged, and the cause can often be recognized by the fact that the breath has the odour of sweet apples, due to the presence in it of acetone, which is a product of fat metabolism.

Another occasional cause of vomiting is the condition known as migraine.

ENURESIS (Incontinence of urine)

In infants the act of emptying the bladder is purely an involuntary reflex one, and it usually takes about two years before the higher centres of the brain obtain full voluntary control over this function. In certain children, however, this control is delayed for some years, this delay occurring slightly more commonly among boys than among girls. In some children the incontinence occurs only during sleep, but in others it may occur also, or only, during the daytime.

Enuresis has been ascribed to a variety of physical causes, such as enlarged tonsils and adenoids, threadworms, the need for circumcision, deficient action of the thyroid, hyperacidity of the urine, etc., and also to certain breaches of hygiene, such as late meals, ill-ventilated bedrooms, too many bedclothes, or sleeping on the back. Although in a few cases one or more of these conditions may possibly be responsible, the view is now held that in the majority of cases the defect is not physical but nervous in origin. The condition is certainly much more frequent in the group of so-called neuropathic children, in which group are included the nervous and highly strung and those who exhibit behaviour disorders.

The defect is found among the well-to-do just as frequently as among the children of the poorer classes. In the former, it is not uncommon to find that the children affected are of the over-excitable type, who, in their early days before they have acquired voluntary control of the bladder reflex, have taken too much to heart the reproofs of their mothers or nurses because of their alleged misconduct. In consequence of this, instead of being care-free, like normal children, they have an ever-present over-anxiety which is often sufficient to bring about the very mishap which they are so anxious to avoid.

Innumerable methods of treatment have been suggested, none of which has been considered of sufficient value to justify its general acceptance. Fortunately, the majority of cases recover in the course of a few years without treatment, but whatever method be adopted there should, at the same time, be made every effort to restore the child's self-confidence. Often a holiday or change of environment is beneficial, this being probably due to the fact that such changes temporarily divert the child's mind from its anxiety.

Admission to hospital often has the same effect, possibly because the children realize that as they have been admitted for the cure of the condition, it would not be regarded as anything unusual for them to wet the bed, and so, their minds being relieved of the anxiety which at home was always present, their voluntary control of the bladder reflex becomes established.

EPILEPSY

Epilepsy is the term applied to a nervous disease, characterized by a sudden loss of consciousness which is usually associated with convulsive movements. There is evidence of the disease being sometimes of a hereditary nature, and it certainly occurs more often in families of neurotic stock. Though the disease may commence at any period of life, it most usually begins between the ages of ten and twenty.

There are two main types of the disease, known respectively as petit mal, or minor epilepsy, and grand mal, or major epilepsy.

In *petit mal* the child may lose consciousness for a few seconds only, at the same time making some slight involuntary movements, such as turning the head, rolling the eyes, or twisting the mouth, but there are no definite convulsive movements. When writing, the child may suddenly drop his pen or pencil, or he may suddenly stop speaking for a few moments and then resume as though nothing had happened, though he may subsequently appear dazed for a few seconds.

These attacks are apt to be mistaken for faintings, but they are more sudden in their onset and recovery, and occur under circumstances not conducive to fainting.

Children who commence with attacks of petit mal may subsequently develop grand mal, and vice versâ.

Grand mal, or major epilepsy, is a much more alarming condition, being characterized by fits of a convulsive nature. In about half the cases the fits are immediately preceded by some kind of warning to the patient, known as an " aura." These may be in the nature of a tingling, numbness or twitching in the face, tongue, arm, or leg, and sometimes flashes of light are seen, or the sensation of smelling an unpleasant odour is experienced.

The stages of the fit are usually three in number.

(1) The *tonic stage.* The actual fit commences with the patient falling down suddenly, often with a loud scream or a cry. The child lies with the back rigid, perhaps slightly arched, and the head drawn backwards and the legs extended. The face may be pale at first, but it gradually becomes more and more congested and eventually quite cyanosed, due to the tonic contraction of the chest muscles, which interferes with respiration.

This tonic stage rarely lasts for more than half a minute, and then passes into the stage of clonic convulsions.

(2) The *clonic stage.* This usually begins with some twitching of the face and eyelids, which rapidly extends to other muscles of the body and limbs.

The characteristic movements are alternate flexion and extension of the limbs, which spectators usually describe as a " working of the limbs," and movements of the eyeballs. The tongue is usually protruded and is apt to be caught between the teeth and severely bitten. Saliva is freely secreted and froths in the mouth. The face becomes livid and the lips and features swollen, the pupils are dilated and the eyeballs are insensitive to touch. Control of the bladder and bowel reflexes may be lost.

(3) The *stage of recovery.* After a few minutes the clonic convulsions gradually subside, breathing becomes easier, the normal colour returns, and the patient remains in a comatose condition for some time, and this gradually passes into a natural sleep.

The condition with which such an epileptic fit is most likely to be confused is a hysterical fit, in which the movements, however, are not as in epilepsy, alternating contractions and relaxations of antagonistic muscles, but tend to be more in the nature of combined movements, apparently made with a purpose or object. Thus the head may be dashed on the floor, but not in such a manner as to injure it, and the tongue is never bitten. The patient may struggle against attempts of bystanders to restrain the movements, and will also resist any attempt to touch the eyeball to discover if sensation be present. Such reflex movements of the eyelids show that consciousness is not lost, as in epilepsy.

During an attack of grand mal the clothing round the neck and chest should be loosened. Some soft material, such as a folded coat, should be placed under the head to prevent its injury during the convulsive stage. To prevent the tongue being bitten, some solid substance, such as a pencil or a piece of wood, should be held between the teeth. The child should be pulled away from heavy furniture, or anything likely to cause injury to him during the attack.

After recovery from an attack of petit mal or grand mal, the patient may perform certain automatic actions of which he is unaware, *e.g.* acts of violence may be committed.

The frequent recurrence of fits, of either type, in the course of time results in progressive mental deterioration, and in many cases actual feeble-mindedness. As the recurrence, frequency, and severity of the fits can usually be considerably controlled by regular treatment, it is very important that those affected should be under constant medical supervision and treatment.

With regard to attendance at school, no definite ruling can be laid down, and each case has to be considered on its merits. There is no justification for excluding a child who suffers from petit mal, but with regard to children suffering from grand mal, the decision with regard to exclusion will depend upon the frequency and severity of the attacks and upon the time of day at which the attacks usually occur, as there would be no need to exclude children in whom fits occur only at night time.

There are throughout the country a few residential schools recognized by the Board of Education for children suffering from epilepsy. Sometimes, if the fits are not too severe or frequent, the cases are admitted into day special schools for physically defective children, where there is a nurse in attendance, and where it is possible to see that the patients are securing regular treatment.

BRONCHITIS

BRONCHITIS or bronchial catarrh is usually due to a bacterial infection of the mucous membrane of the bronchial tubes, is a fairly common affection of young children, and is one of the most important causes of the absences of children from school. Certain of the communicable diseases, such as measles, the common cold, influenza, and especially whooping cough, are frequently accompanied by some bronchitis, and children suffering from rickets are particularly susceptible to acute or chronic attacks of this disease.

A predisposing cause of the condition is living in overcrowded or overheated rooms, the atmosphere of which dries up the respiratory mucous membranes and so renders the children very liable to contract catarrhal affections. Another effect of living in an unventilated and overheated atmosphere is that a chronic rhinitis is apt to be caused, together with enlargement of the tonsils and adenoids. The resultant nasal obstruction forces the child to breathe through the mouth instead of through the nose. This causes the inspired air to be deprived of the warming which it should receive by passage through the nose, and consequently the bronchial tubes get chilled, particularly in cold weather, and the power of the mucous membrane to resist infection by invading organisms is reduced.

Attacks of acute bronchitis should receive immediate treatment, for there is always a possibility of the condition becoming chronic, or of the inflammation extending to the smallest bronchioles and leading on to broncho-pneumonia.

CHAPTER 21

NERVOUS AND DIFFICULT CHILDREN

The causes and signs of nervousness in children. Habit-spasms. Hysteria. Anxiety states. Factors influencing behaviour. Child Guidance Clinics.

THE NERVOUS CHILD

PSYCHOLOGICAL investigation has shown that many of the neuroses or nervous breakdowns of adult life, such as that known as an "anxiety state," are the culmination of insidious and continued emotional disturbances originating in childhood. It is highly desirable that the existence of such emotional disturbances should be promptly recognized and steps taken to counteract them before it is too late, and the early education of children therefore should be undertaken only by persons who have an understanding of the unfolding and proper development of a child's emotions.

The foundations of a child's character and personality are largely moulded during pre-school years by the experiences of home life, and the up-to-date teacher who appreciates this fact studies the individual characters of the children under her charge, and frequently has to endeavour to remedy character defects resulting from unwise parental handling.

The human brain is a machine of such marvellous complexity that it is surprising that its working does not get disordered more frequently than it does.

At birth the brain is largely undeveloped, only those parts necessary for the immediate necessities of life being mature, and for some months after birth the child's activities are mainly instinctive in nature. Later, the child begins to develop those feelings of emotion which are of value in the gaining of experience.

These emotions are self-centred in type, such as those of pleasure, anger, and fear, and there is nothing abnormal in occasional incidental and emotional outbursts so long as they are merely transitory. As the child grows older many more complex emotions are formed, such as those of love, jealousy, and pity; at a still later stage there develops a conscious restraint of all emotional reactions by the evolution of faculties which enable the child to regulate and control such reactions according to circumstances.

In a certain number of cases children are born with a congenital hypersensitivity of the nervous system, but in other cases the condition is acquired, as a result of environmental conditions. Children readily react to the particular conditions under which they live, and if the protective parental care necessary for the infant be unduly prolonged, or the child be continually protected from imaginary potential dangers, there is every likelihood of the emotion of fear becoming unduly exaggerated. When this occurs, as in the case of an only child, the child may have to suffer acutely in later life for the misguided over-attention it received in earlier years.

In all individuals, everyday experiences evoke some mental feeling, but when the emotional response is out of proportion to the stimulus inciting it, the condition is abnormal.

Temporary emotional disturbances in childhood may result from such physical causes as (1) fatigue, as shown by the outbursts of temper or peevishness of the tired child; (2) the effects of toxæmia, resulting from constipation, septic teeth or diseased tonsils; (3) abnormal action of certain of the ductless glands, as discussed in Chapter 2.

Psychologists regard the conscious mind as but a very small portion of the whole of the mind, by far the greater portion being what is known as the subconscious mind. This subconscious mind exerts a profound action on all mental activities, since it serves as a sort of mental storehouse for all the experiences of life, most of which have been forgotten. Some of these subconscious memories can, however, by the effort of the will, be readmitted to the conscious mind. But in the case of experiences of an unpleasant nature some may become repressed, that is, prevented from being brought back to conscious remembrance. Thus the memory of many of the early difficulties of life and shocks to the emotions and other early unpleasant experiences, as in the case of children who have been subjected to excessive fright or have been assaulted, may be repressed from the conscious mind, and when this occurs it is apt to give rise to conflicting emotions in the subconscious mind, which may bring about what is known as " hysteria " or an " anxiety state." These conditions are described later.

In the case of most children some nervous instability is not uncommon, but the characteristically nervous child is abnormally highly strung, and at parties gets wildly excited and subsequently becomes exhausted. Such children are often very impressionable, highly sensitive, and timid ; most of them are also highly emotional, easily blushing or crying.

Disorders of sleep are common, either the children have difficulty in getting to sleep, or they sleep restlessly, sometimes talking in it, or awakening with night terrors. Headaches are also experienced, particularly in school children, any over-excitement or school pressure being sufficient to cause them. The affection of certain of the higher centres may result in enuresis or stammering. Many of the children are also nail-biters.

Habit spasms, or so-called " tics," are sometimes met with in nervous children, the most common forms being a constant blinking or screwing-up of the eyes, or elevation of the eyebrows, facial twitchings involving the nose or mouth muscles. Other forms are vocal, such as a constant clearing of the throat. Some of these tics are sometimes mistaken for choreic movements, but tic movements, unlike choreic movements, do not interfere with voluntary action. For example, a child with some tic movement of the hands can pick up a pin from the ground quite easily, whereas a choreic child will do so with difficulty.

It is most important that those who have to deal with nervous children should have a thorough understanding of the working of their minds, and be possessed of sympathy and discretion. Often by the time such children attend school much damage has been done by unwise handling at home. It is quite useless to try to harden timid, sensitive children, and great care must be taken with their education. Thus, if it be found that any particular subject, such as arithmetic, causes too great a strain, that subject must be taken in small amounts only. Corporal punishment should not be given to over-sensitive children, as the effect on the mind may be serious.

Physical training and dancing are valuable means of teaching control to the higher intellectual and motor centres. Education under open-air conditions is often valuable, and if the condition be attributable to " overmothering " it is often helpful to send the child away to a residential open-air school.

As previously stated, the effects in later life of unbalanced emotional responses may be manifested in the form of hysteria or an anxiety state.

HYSTERIA

HYSTERIA is the name given to the condition whereby people affected with disproportionate emotional responses, when they find conditions too difficult for them, seek relief by making, through the medium of their subconscious minds, a temporary mental withdrawal from the realities of life with the object of evading them, or achieving thereby some desired result, such as the securing of sympathy and attention, or, in the case of children, evading lessons. It should be emphasized that such hysterical manifestations are not deliberate on the part of the persons concerned, or in other words, that the sufferers are not malingering, for they are quite unaware, in their conscious minds, of the motives of the subconscious mind in inspiring the hysterical manifestations.

The type of child susceptible to hysteria is usually one who has a lively imagination, is highly emotional, egotistic, and has a fondness for appearing important and exciting the attraction and admiration of others. It is largely from such children that unfounded complaints against teachers may emanate; for example, they may simulate injuries which they allege have been caused by a teacher whom they dislike, hoping thereby to cause trouble for the teacher.

The commonest hysterical manifestations which occur in school are emotional outbursts in the form of passionate sobbing, more dramatic than natural, or in more severe cases, the simulation of an epileptic fit, which, however, differs from true epilepsy in the fact that the movements are more purposeful, such as a flinging about of the limbs, which contrasts with the regular contraction and relaxation of the muscles in true epilepsy. The reflexes, such as the bladder, bowel, and conjunctival are not lost in hysterical fits, and the children seldom bite their tongues or injure themselves in falling.

Less familiar to teachers, but well recognized by doctors, are certain other manifestations of hysteria. These include on the motor side, the simulation of certain forms of paralysis and contractures, and disorders of gait, whilst on the sensory side there are instances of disorders of vision and hearing, digestive and circulatory disturbances. Cases of loss of memory, states of trance and somnambulism may also be attributable to this condition.

ANXIETY STATES

ADULTS suffering from an anxiety state may exhibit one or two or many of the following symptoms: An early ensuing fatigue out of all proportion to what one would expect from the amount of work done and the person's general condition, a feeling of a weight in the head, attacks of giddiness, insomnia, indigestion, palpitation of the heart, and a consciousness of the heart beating whilst in bed. Amongst the mental symptoms, vague fears and constant anxieties concerning trivial or non-existent difficulties are ever present. Difficulty in concentration and loss of memory may occur, and the patient become shy and awkward in the presence of other people. Obsessions or unreasonable fears of heights, open or closed spaces, trains, etc., may arise.

DIFFICULT CHILDREN

AMONGST the child population there is always a certain number of children who present a problem to parents, teachers, and school medical officers, because their behaviour does not conform with the recognized moral and social conventions.

Child guidance clinics have been established for the purpose of investigating the emotional responses, social relationships and environmental conditions of such children, and remedying any detrimental causes discovered, in order that the child may develop into a well-balanced adult.

To appreciate the methods by which the personnel of experts attached to such clinics work, it is necessary to have some understanding of the psychological processes which determine temperament, character and behaviour, qualities in which no two children are exactly alike.

In all forms of animal life instinctive force exerts a potent influence in maintaining the existence of the species, but amongst civilized people its presence is usually masked, being controlled by the higher intellectual centres of the brain. Among the more important of human instincts which may influence conduct are the acquisitive, sexual, wandering, and combative instincts.

The *acquisitive instinct* is evidenced by boys who store rubbish in their pockets, collect postage stamps or cigarette cards, and in the case of older people, by those who collect old china, books, antiques, etc., or, to give an extreme example, by the miser who hoards, but does not utilize, money.

The *sex instinct*, although it is not fully developed until adolescence, is responsible, in its immature state, for the bonds of friendship and comradeship between members of the same sex during school life.

The *wandering instinct* has its outlet in cycling, trekking, and camping activities, and in the nomadic life of gypsies.

The *combative instinct* is still strong in uncivilized races, and newspapers daily report cases where civilized people have committed the anti-social act of taking the law into their own hands. The watching of bull fights and boxing matches is nothing more nor less than a gratification of the combative instinct.

Organized society cannot tolerate uncontrolled instinctive actions, and requires that behaviour shall be rational and not dictated by unrestrained feeling. The infant, however, is not a rational being and has only instinct upon which to base its behaviour, and wise parental guidance and control are consequently necessary to limit these natural instincts and desires, in order that the child may grow up into an adult suited for community life and prepared to conform to its accepted laws and conventions.

It will be seen, therefore, that the first few years of life are extremely important, for, during this period, the child's character is becoming moulded into a certain pattern which will, under ordinary circumstances, remain unaltered for the remainder of its life. The particular pattern is determined to a considerable extent by the child's training and environmental experiences, an important influence in subjugating instinctive forces and developing character being the precepts, admonition, and good example of the parents.

A well-brought-up child usually acquires in later childhood a moral and social sense, a desire for correct conduct and a real feeling of regret for misconduct, but when these dawning social sentiments conflict with powerful but repressed instincts at the period of adolescence, temporary emotional disturbances are specially apt to occur.

For happiness at all periods of life, co-operation with others is essential, first in the home, then at school, and later with the community in general. The sooner, therefore, a child learns the principles of co-operation the better its chance of securing a happy disposition. Children brought up in homes free from quarrelling, jealousy, deceit, and exhibitions of selfishness, will learn by example to keep their instinctive forces under control.

CHILD GUIDANCE CLINICS

THE more common types of cases dealt with at child guidance clinics comprise those of backwardness at school, truanting, emotional instability as shown by disobedience, hysteria, exhibitions of temper, excessive fears, sleep-walking, wandering from home, unmanageability, lying, stealing, and occasionally sex difficulties.

The following is a classification of the more important factors which have been found to influence behaviour, and careful consideration is given at the clinic to all of these factors.

(*a*) *Heredity.* Evidence in the family history of backwardness, mental deficiency, insanity, neurosis, criminality, alcoholism, or certain physical disorders such as epilepsy, may indicate direct inheritance of instability, which may be manifested either by nervous symptoms or by abnormal behaviour.

(*b*) *Home environment* may act adversely in one of two ways: either indirectly, when the child is being brought up in an atmosphere of domestic friction, vice or general disorder, or directly, when the child is either spoilt by indulgent parents at home or is snubbed and suppressed. The loss or prolonged absence of a parent or the advent of a step-parent may adversely affect the home environment, whilst the lack of uplifting pursuits and facilities for amusement may cause the child to find his recreation away from home, possibly in the company of undesirable companions.

(*c*) *School and educational difficulties* may be caused by the particular methods of teaching or of enforcing discipline, change of school or class, frequent or prolonged absence through illness; consequently, a detailed history of the child's school life is always necessary for the proper investigation of the cases of school children.

(*d*) *Physical deformities* or chronic ill-health are very liable to lead to feelings of inferiority on account of the specialized treatment which many cases require, since such special treatment is the antithesis of every normal child's desire to be just like other children.

(*e*) *Mental dullness*, if present, must be considered from the point of view of whether or not there exists sufficient intelligence to keep in check instinctive tendencies.

(*f*) *Mental disturbances*, resulting from frights, unpleasant experiences, death of a parent, etc., or temperamental changes due to disordered endocrine action.

The determination of the cause or causes of misbehaviour in children is by no means an easy matter, since it may be, and often is, attributable to a combination of physiological, mental, emotional, or environmental factors. The necessary detailed expert knowledge of medicine, psychiatry, psychology, education, and social science required for gaining an insight into such children's particular difficulties can, however, seldom be secured in any one individual. It is usually necessary, therefore, for cases to be investigated by more than one person, and the essential minimum staff of a child guidance clinic usually comprises the three following experts :—

(1) A *Psychiatrist,* who is a medical practitioner with specialized knowledge of the working of both the normal and the abnormal mind, and of the methods whereby treatment in abnormal cases can best be carried out. This officer is usually in charge of the clinic, though sometimes an independent medical man may be appointed as director of the clinic.

(2) A *Psychologist,* who is an expert in estimating the intellectual and educational capacities of the child.

(3) A *Social Worker* with special training.

It is not necessary that all the cases should be investigated by each of the experts, but for the difficult cases the three-sided approach is available.

It is an advantage for the clinic to be in touch with the specialists forming the staff of a children's hospital, for examination of the child may reveal the existence of defective sight or hearing, the presence of chorea or some crippling condition, any of which may require treatment.

The psychological investigation is for the purpose of ascertaining the children's mental and educational capacities, and may elucidate any particular abilities or disabilities.

The psychologist has usually been trained as an educational specialist also, and his knowledge, therefore, of the technique of both teaching and learning is of considerable value. During his investigation of the intellectual capacities, he also observes the child's temperament and the characteristics of his whole personality as revealed during the interview.

The duty of the social worker is to carry out, under the instructions of the psychiatrist, the visiting of the homes and the schools, the observing of environmental conditions, and the interviewing of parents, teachers, and others with whom the child comes into contact in everyday life, as thereby much valuable information may be obtained. In the after treatment of the cases, it is her duty to keep in contact with the family and to see that the particular treatment or conditions advised by the psychiatrist are being properly carried out.

When the preliminary investigations by the clinic officers are completed, a " case conference " is held, at which these officers are present, and the individual clues obtained by the different workers are fully discussed, so that the probable causes of the child's misbehaviour are brought to light.

When the cause has been discovered, steps can be taken to remedy any existing adverse physical conditions, and any educational difficulties can be dealt with by consultation with the teacher. Again, opportunities for recreation may have to be found, and at some clinics arrangements are made for groups of children to attend once or twice a week for organized play, for the purpose of promoting any requisite social or temperamental adjustment, such as the overcoming of excessive shyness. To remove any home difficulties is a bigger problem, especially if the difficulty has been parental mishandling, and it is consequently very important that the social worker should not only be trained for her particular work, but must have an impressive personality and be possessed of great tact.

Only too often it is found that it is really one or both of the child's parents who require adjustment, and in such cases an endeavour is made to enlighten the parents responsible, and, moreover, it is part of the duty of the social worker, in her home visiting, to encourage and assist the parents.

The following is an interesting example of unsatisfactory home conditions adversely influencing the conduct of a child, but where the mother really required treatment. An eleven year old boy was reported as backward and of uncertain temper, having once threatened his mother with a knife. On examination he was found physically normal but educationally backward. It was ascertained that the home conditions were far from satisfactory, as the parents were not on good terms, mainly owing to the fact that the mother was obsessed by the idea that she ought to have been on the stage. She considered that there she would have been a great actress, and was constantly strutting about the house in a histrionic manner, which considerably irritated her husband. On advice, the father agreed to the boy living for a time away from home and joining a certain boys' organisation. This was arranged for, and the boy soon became happy and no longer showed exhibitions of temper. After returning home he made such excellent progress at school that he eventually gained a scholarship at a higher school.

LEFT-HANDEDNESS.

As tools, machinery, etc., are designed for right-handed persons, left-handed adults may find their abnormality a bar to their taking up certain occupations and a handicap in seeking employment in certain trades. It has been estimated that about 4 per cent. of school children are left-handed, hence the habit is a matter of some importance.

For some months after birth children are ambidextrous, but gradually the majority begin to show a preference for using the right hand as the master hand. Should they, however, show signs of left-handedness, this is the ideal time to rectify the abnormality. Treatment at this period is obviously a matter for the parents, but it is desirable for doctors and health visitors at infant welfare clinics to watch for left-handedness and to give the necessary advice.

Occasionally left-handedness is hereditary, and in such cases it is probably of little use to attempt to correct it.

In training children to be right-handed it is important to remember that left-handed children are usually more temperamental than others, and any attempt to train them in the use of their right hands should be discontinued at any signs of emotional disturbance, such as the appearance of an inclination to stammer.

CHAPTER 22

MENTAL DEFICIENCY, DULLNESS AND BACKWARDNESS

Causes of mental deficiency. Legislation relating to it. Physiology and psychology of the condition. Variations in mentalities. Mental tests. Special education. Moral deficiency. Causes and treatment of dull or backward children.

FROM the point of view of mentality every child may be considered as belonging to one of the following four groups :—

(1) The supernormal.

(2) The normal, including the normal but backward.

(3) The dull.

(4) The mentally defective : (*a*) feeble-minded ; (*b*) imbeciles ; (*c*) idiots ; (*d*) moral defectives.

In dealing with this subject it has been found more convenient to defer dealing with the " normal but backward " and the " dull " children until the mentalities of mentally defective children have been discussed.

MENTAL DEFICIENCY

THE question of how best to deal with the difficulties raised by the presence in the community of comparatively large numbers of mentally defective persons has of recent years been receiving increasing attention, since it is now realized that this group is closely associated with many of the problems of social inefficiency.

Mental deficiency is often regarded as being hereditary, but this is by no means always the case. It is true that a few pedigrees have been worked out, in which it would appear that the defect has been transmitted as a Mendelian recessive factor, but in the majority of cases no such hereditary transmission can be demonstrated. This is not surprising, considering that the defect is not a specific disease but must be regarded as a symptom of some abnormality of the brain which may have been caused in several different ways, as, for example, by :—

(1) Some injury to the brain before birth, at birth, or subsequently.

(2) An insufficient secretion of the thyroid gland, leading to the condition known as cretinism.

(3) An attack of encephalitis lethargica (sleepy sickness) or meningitis during childhood, in consequence of which certain brain cells have been destroyed, with the result that the children have become mentally defective.

(4) A wholesale cutting off of sensory avenues from the time of birth, such as sight or hearing, may, unless the children receive special education, result in a failure of so many of their immature brain cells to develop, as to place them on the intellectual level of a mentally defective.

In the majority of cases, however, no such direct causative factors can be demonstrated, and the condition can then only be regarded as congenital in origin, and in some of these cases, although it has not been definitely proved, it is considered that alcoholism, syphilis, mental deficiency, epilepsy, or insanity in the case of one or other of the parents may be predisposing causes.

The first official recognition of mentally defective children was the passing of an Education Act in 1899, which made it the duty of local education authorities to ascertain what children in their areas, whilst not being imbecile, and not being merely dull or backward, were, by reason of mental defect, unable to obtain proper benefit from education in the ordinary public elementary schools, but were capable of being educated in special schools, which the education authorities were empowered to provide. It should be noted that this Act, the provisions of which are now incorporated in Part V of the Education Act, 1921, dealt merely with educable mentally defective children.

In 1913 and 1927 two Mental Deficiency Acts were passed which dealt with both educable mentally defective children and uneducable mentally deficient persons of all ages. These mentally defectives were classified into four grades—idiots, imbeciles, feeble-minded and moral defectives, the definitions of these terms in the Act of 1927 being as follows :—

Idiots are " persons in whose case there exists mental defectiveness of such a degree that they are unable to guard themselves against common physical dangers."

Imbeciles are " persons in whose case there exists mental defectiveness which, although not amounting to idiocy, is yet so pronounced that they are incapable of managing themselves or their affairs, or, in the case of children, of being taught to do so."

Feeble-minded persons are " persons in whose case there exists mental defectiveness which, though not amounting to imbecility, is yet so pronounced that they require care, supervision, and control for their own protection or for the protection of others, or, in the case of children, that they appear to be permanently incapable by reason of such defectiveness of receiving proper benefit from the instruction in ordinary schools."

Moral Defectives are " persons in whose case there exists mental defectiveness coupled with strong vicious or criminal propensities, and who require care, supervision, and control for the protection of others."

At first sight it might appear that in view of the passing of the Mental Deficiency Acts the section of the Education Act dealing with mental defectives ought to have been repealed. This was not done, because the two Acts dealt with the question of mental deficiency from different points of view, the Education Act being solely concerned with the question of the education of feeble-minded children of school age in special schools or classes, while the Mental Deficiency Act was concerned also with children who are imbeciles, idiots, or moral defectives, and with the question of the social capacity of all mentally defective persons over school age; that is to say, the defectives who are incapable of obeying the laws and of complying with the moral code of the community, unless they are placed under some sort of supervision or control. A child who is defective according to the definition of the Education Act, when he leaves school may not necessarily also be defective according to the definition in the Mental Deficiency Act. In other words, he may be quite capable of complying with the moral and legal obligations of society without requiring supervision or control.

For a proper understanding of mental deficiency, it will be useful to consider the functioning of the mind, firstly, from the biological aspect; secondly, from the physiological side; and lastly, from the psychological point of view.

BIOLOGICAL ASPECT OF MENTAL DEFICIENCY. Dr. Tredgold considers that the best criterion of mental deficiency within the meaning of the Mental Deficiency Act is to consider it from a biological point of view; that is, to decide whether or not thehigher centres of thebrain of the individual are sufficiently developed to enable him to carry out satisfactorily the necessary functions for which they are intended.

Evolution has been largely brought about as the result of Nature's law of the "Survival of the Fittest." As Darwin pointed out, various animals have facilitated the survival of their species by developing certain distinctive characteristics, such specialization being mainly in the provision of methods of offence or defence, or both. Thus, the lion and the tiger are familiar examples of animals endowed with powerful weapons of offence, whilst the more timid animals, such as the deer and the hare, are endowed with fleetness of foot to enable them to escape as their method of defence. The bee and the jelly fish have their stings, and the chameleon has the wonderful gift of being able to change its colour so as to match its particular environment.

Both in natural methods of offence or defence, however, man compares very unfavourably with the lower animals, and had it not been for the exceptional development of his mind, he would have long ago been extinguished. It appears, therefore, that the practical advantages of the mind with which Nature has endowed man is to enable him to maintain his existence and adapt himself to his particular environment.

The central nervous system of man, which is exceedingly complex, has gradually been evolved from comparatively simple forms, such as still exist in the lowest forms of vertebrates. Experts in Comparative Anatomy can trace, almost step by step, the stages of the progressive evolution of the central nervous system through fishes, reptiles, amphibia, and birds, then through the lower and higher types of mammals, culminating in its highest development in man.

A study of this evolutionary progression from the simple to the complex shows that it has been achieved by the progressive building up of additional nerve elements at the head end of the primitive nervous system, the latest development being that of the cerebral hemispheres, which, though present in all mammals, are specially highly developed in man, and are the outstanding characteristic of his nervous system (see Fig. 69).

PHYSIOLOGICAL ASPECT OF MENTAL DEFICIENCY. In order to appreciate how the mental processes of a mentally defective differ from those of a normal person, it will be useful to deal briefly with the condition from the physiological point of view.

As the working of the normal mind is largely dependent upon the correct functioning of a highly complicated mechanism of so-called reflex actions, it is necessary to have an

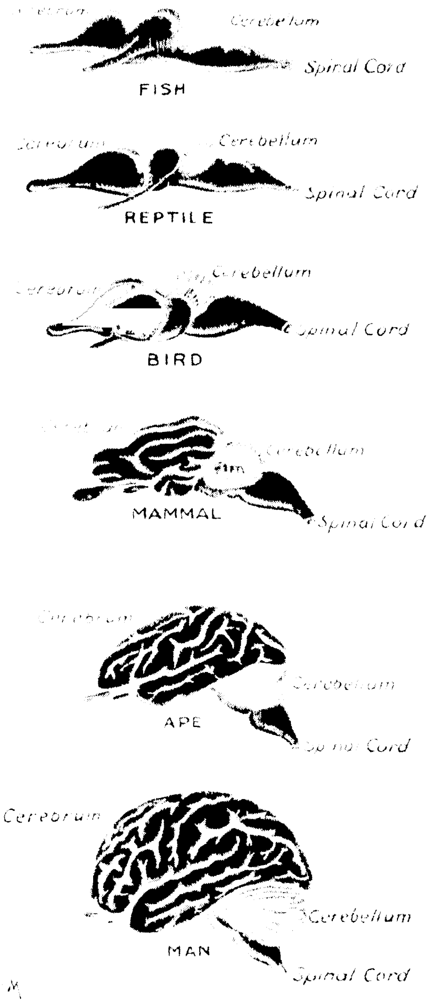


FIG. 69. *Diagrams showing the relative sizes of the Cerebrum compared with the rest of the brain in the case of man and various animals.*

(Reproduced from "The Outline of Science," by permission of Messrs [illegible]

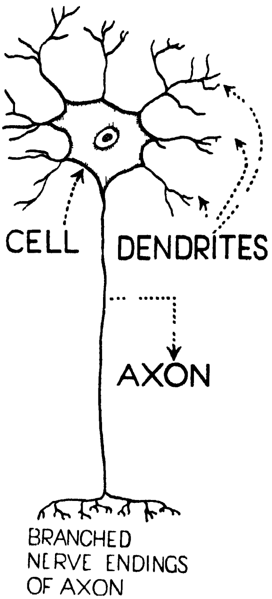


FIG. 70. *Diagrammatic representation of a Nerve Unit or Neurone.*

understanding as to what is meant by reflex action and the fundamental principles involved. This can best be done by describing one of the simplest forms of reflex action.

By *reflex action* is meant any automatic involuntary action which occurs in response to a stimulus. For example, if the hand touches something very hot it is immediately, and without conscious effort, withdrawn by reflex action.

The nervous system consists of vast numbers of nerve units, known as "Neurones," a neurone being the name given to a nerve cell and all its processes. Most types of nerve cells have two or more processes known as nerve fibres, one of which is usually unbranched until just at its termination, and is known as the axon, the other processes, which are known as dendrites, being branched. In every cell the nervous impulses always pass in one direction only, namely, from the dendrites to the nerve cell, and from the nerve cell along the axon.

At its free end, which may be a considerable distance away from its cell, the axon terminates in branches which interdigitate with, but do not come into actual contact with, the branching dendrites of one or more other nerve cells. The break in continuity between the branched end of the axon of one neurone, and the dendrites of another neurone, is spoken of as a "synapse." Nervous impulses can, however, pass over this synapse, but the method by which this is done is not exactly known.

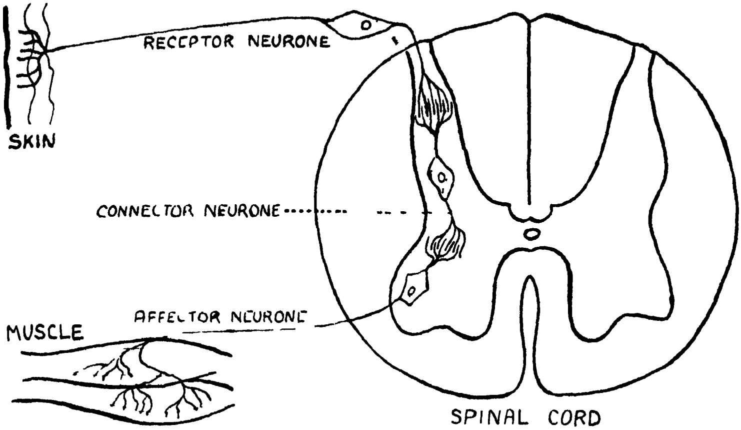


FIG. 71. *Diagram showing Neurones involved in a simple reflex.*

The simplest forms of reflex actions occur in connection with the spinal cord and involve three types of neurones as follows :—

(*a*) A *Receptor neurone,* the nerve cell of which is situated in a ganglion in the posterior root of the spinal cord. The termination of the dendrites of this cell are situated some distance away, *e.g.* in the skin, whilst the axon passes from the cell into the posterior horn of the grey matter of the cord where it synapses with the dendrites of

(*b*) a *Connector neurone,* the axon of which passes to the anterior horn of the spinal cord to synapse with the dendrites of

(*c*) an *Effector neurone,* the cell of which is in the anterior horn of the grey matter of the cord, the axon of which cell passes out of the anterior root of the cord to terminate in some organ of response, such as a muscle.

If the foot treads on something sharp, the foot is immediately withdrawn by reflex action, which is brought about in the following way :—

The sharp piercing of the skin stimulates the nerve endings of a dendrite belonging to a receptor neurone, and a message is transmitted through its cell in the ganglion in the posterior root of the cord, and then along its axon as far as the first synapse in the posterior horn of the spinal cord. The impulse jumps this synapse and is then transmitted through the cell of the connector neurone to its synapse with the effector neurone in the anterior horn. The impulse jumps this second synapse and passes along the dendrite to the effector neurone cell, from which an impulse is sent along its axon to the nerve endings in the muscles controlling the foot, whereby the muscles concerned are contracted and the foot withdrawn from the painful stimulus.

Though there is still much yet to be discovered concerning the mechanism of the human brain, it is more or less certain that the functions of the mind are carried out by the grey matter of the cerebral hemispheres. It has been clearly demonstrated that certain defined areas of the cerebral cortex control the movements of the voluntary muscles or are associated with sensory impressions from the organs of special sense, such as the skin, muscles, etc. But there are also large tracts of the cerebral cortex called " Silent " or " Association " areas, concerning the functions of which comparatively little is known, beyond the fact that they are, somehow or other, specially concerned with the mental functions necessary for memory and intelligent behaviour.

The grey matter, or outer part of the cortex of the cerebral hemispheres, can be considered as composed of three main layers :—

(1) An outer layer, which is composed largely of nerve cells, and is concerned with the higher intellectual and moral qualities of the mind.

(2) A middle layer, which is also composed largely of nerve cells, and has the function of acting as a sort of receiving base for sensory impressions.

(3) An inner layer, which consists mainly of nerve fibres

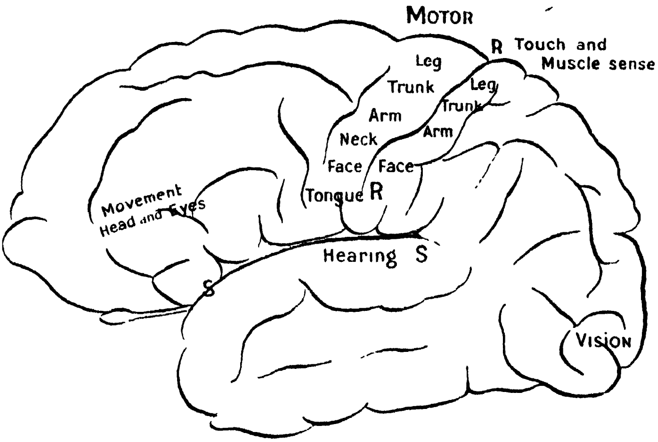


FIG. 72. *Diagram of the left Cerebral Hemisphere showing areas concerned with various functions. The chief "silent" or "association" areas are to the left of the "motor areas" in the diagram.*

(*From "The Functions of the Body," by V. H. Mottram.*)

and nerve cells and controls the lower voluntary and instinctive functions such as self-preservation and sex.

Physiologists have shown that the cerebrum contains many millions of neurones, probably the majority of them being connector neurones interposed between receptor neurones and effector neurones. An incoming nerve impulse from a receptor neurone may have to pass through a maze of connector neurones in the cerebrum before arriving at the appropriate effector neurone or neurones.

The branched ends of the axon of a neurone often interdigitate with the dendrites of more than one connector neurone, and the nerve impulse may be accepted by one of these neurones but declined by others, the impulse passing on from one connector neurone to another, at each stage being accepted by some particular neurone and declined by others, until finally it reaches the appropriate effector neurone.

It is on the proper functioning of these connector neurones

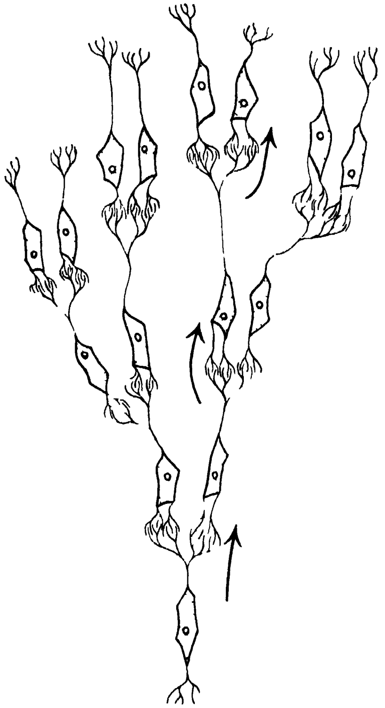


FIG. 73. *Diagrammatic representation of Connector Neurones showing how the impulse is accepted by some Neurones and declined by others.*

in determining that all nerve impulses shall be piloted along the correct channels that the efficiency of the human mind depends.

Some of the connector neurones appear to have the power of functioning as censors, by completely holding up the passage of certain nerve impulses. In normal individuals the potentiality of undesirable instinctive actions is always present, but the carrying out of such actions is inhibited by these neurones which suppress such impulses. In the case of mental defectives, however, probably on account of this censorship being inadequate, instinctive reactions to environmental factors are less controlled. Thus, if a child gets accidentally injured by another child during play, the sensation of pain is conducted to the brain, where the animal instinct of self-preservation is aroused, which if not censored. would immediately lead to automatic reflex retaliation.

In the case of a normal child, however, the higher intellectual centres at once appreciate that the injury received was unintentional, and so they inhibit the carrying out of any reflex retaliation. But in the case of a feeble-minded child such inhibition may not take place, either because there are no cells capable of perceiving that the injury was accidental, or if there be such cells the lines of communication to them are so faulty that the message when received is too late to inhibit the reflex action.

All one's thoughts, judgments, speech, behaviour, etc., are dependent upon this highly intricate maze of cerebral neurones, but the quantity, quality and efficiency of these neurones are not the same in any two individuals. The result is the infinite variety of types of mental equipment found amongst the various individuals comprising the community.

The working of the complicated cerebral reflexes may be likened to the processes involved in a long-distance telephonic communication, in which the message on its journey has to pass through various telephone exchanges, at each of which the telephone operator may have under her control hundreds or thousands of different lines, with any one of which the caller might be connected. If each operator is efficient the right line is selected at each of the telephone exchanges en route, and, provided that all the lines and the apparatus are in working order, the message gets through in as short time as possible to its correct destination.

The working of the brain of the mentally defective child can be compared with that of a telephonic system in which there are too few operators, and some of those on duty are inefficient. whilst some of the apparatus is faulty, in consequence ot which some calls never get through at all, whilst those which do get through are unduly delayed, and some of the calls are connected up with the wrong number.

It is the generally accepted view that mental deficiency is attributable either to congenital deficiency of, or injury to, cerebral neurones, or to some factor causing arrest of development of the immature neurones, this view being largely based upon the fact that microscopical examination of the brains of mentally defective persons reveals definite evidence of such neurone deficiency.

At birth, approximately only half of the nerve cells of the outer layer of the cerebral cortex, which is concerned with the higher intellectual and moral qualities of the mind, are fully developed, and in order to develop the other half it is necessary that they should receive sufficient and appropriate stimulation. It is obvious, therefore, that any wholesale cutting off of sensory stimuli, such as occurs in the case of a child born deaf or blind, would result in non-development of large numbers of the immature nerve cells.

What exactly the mind is, is not really known, and it is considered by many that what is spoken of as "consciousness" is not a mere function of the brain, but that this unknown something, called consciousness, utilizes the brain as its instrument.

PSYCHOLOGICAL ASPECT OF MENTAL DEFICIENCY. For the purpose of comprehending the functioning of the mind from the psychological point of view, the following exposition modified from Tredgold is given. It is convenient to regard the mind, using this word in the wide sense, as composed of three distinct sub-divisions, which we may term the Learning section, the Wisdom section, and the Sentiment section.

The Learning section is the one which is essential for education and comprises the ability to appreciate symbols, such as the combinations of the various letters of the alphabet, essential to reading and writing, and the numerals for the purpose of calculation. Under this heading would also be included the ability for complex thought and the formulation of ideas.

The Wisdom section comprises those attributes which are referred to as will, reasoning capacity, prudence and foresight. As Tredgold says, wisdom is not a single psychological function, but is the result of the interaction of foresight, judgment, and will. It comprises more than the ability to acquire knowledge, or to talk intelligently, or to adapt oneself to the needs of the moment. By it a person makes use of the experiences of past mistakes in guiding his course for the future, and by it instinctive tendencies are restrained and self-control developed. A person possessing an average amount of the attributes which go to make up wisdom is, in ordinary language, referred to as " endowed with common sense." Many persons academically bright at school or college often fail subsequently to make a success of their lives because of their lack of wisdom, and in consequence they are left behind by those whom they formerly beat easily at school.

The Sentiment section is the one concerned with the æsthetic, religious, social, and moral senses. The emotions are included in this sub-division, the most primitive of these, which animals also possess, being hate, affection, fear, and anger, whilst among the more complex emotions may be mentioned disgust, gratitude, wonder, shame, and remorse. At a later stage of evolution sentiments on a higher level are developed, including the æsthetic sense, which enables beauty and harmony to be appreciated, a religious sense whereby there is developed a reverence towards a Supreme Being, a social sense whereby the obligations due to other members of the community are appreciated, and a moral sense in which the highest altruistic ideals are aimed at. The feeble-minded possess, though in a somewhat unrestrained form, the more primitive emotions, such as affection, anger, etc., but the higher sentiments in them are poorly developed.

A mentally normal child may be regarded as one in whom each of the three sections of the mind referred to is satisfactorily developed, so that he is capable of receiving proper benefit from ordinary educational methods. He possesses an average amount of common sense, and his emotions are properly developed and under good control.

No two persons, however, are actually mentally alike, and the differences may be largely accounted for by variations in the relative proportions of the different attributes included in the learning, wisdom, and sentiment sections of the mind.

The following examples, modified from Tredgold, are given to show the effect of certain of these variations :—

(1) Children who are otherwise normal may have that part of the mind poorly developed which is necessary for the appreciation of symbols, and will consequently experience great difficulty in reading, such as occurs in cases of word blindness.

(2) When the only defect of the mind is a definite deficiency of wisdom, such persons may be described as moral learned fools. These persons have sufficient intelligence to enable them to deal with day-to-day requirements, but have not the ability to foresee and provide against future possible contingencies. The mentality of certain types of illogical " cranks " is also of this order.

(3) The ignorant but highly successful business men are examples of persons lacking in learning, but possessing more than average common sense.

(4) Where an individual has an abundance of wisdom but is considerably lacking in moral sense, he is very likely to be successful, though his methods are apt to be unscrupulous. The type of mind of shady financiers is probably of this order.

(5) A morally defective person is almost totally deficient in the moral sense and partly so in wisdom, though little or nothing may be wrong with that part of the brain which is concerned with education. Because of the lack of moral sense there is a total disregard for the feelings of others, and because of a deficiency in wisdom such a person has not sufficient sense to realise that wrong-doing does not pay.

(6) In the case of the mentally defective there is usually an all-round deficiency as regards learning, wisdom, and sentiment, to such an extent as to necessitate special education in the case of children, and often supervision in adult life.

It is not often that mental deficiency is recognized before school life, except in the case of idiots and imbeciles. The

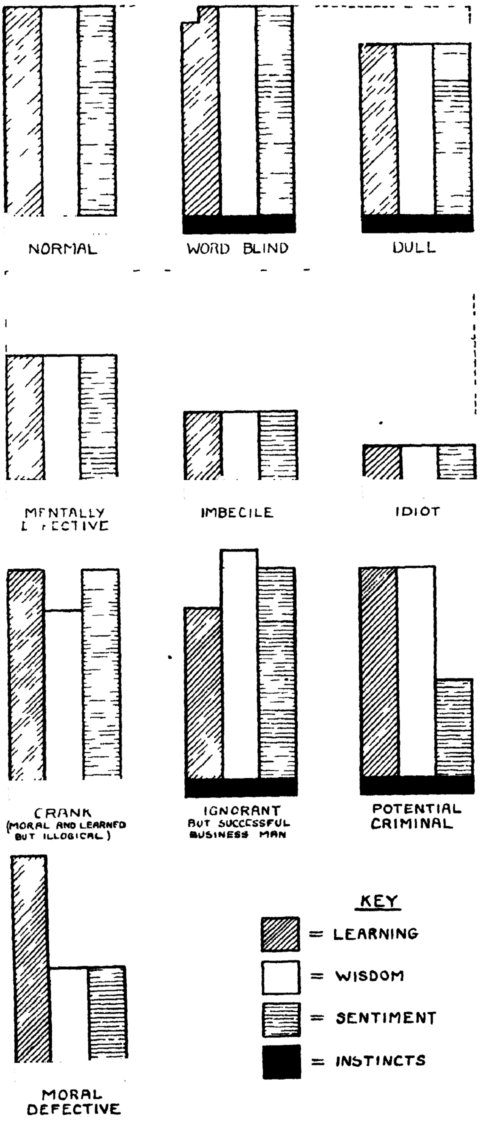


FIG. 74.

Diagrammatic representation of various types of mentalities.

evidences of the defect in these cases is usually so obvious as to cause the parents to seek advice. In the case of feeble-minded children, however, there are usually no symptoms in early childhood so outstanding as particularly to attract the attention of the parents.

DIAGNOSIS OF MENTAL DEFICIENCY

MENTAL TESTING. The first scientific attempts to analyse and standardize the intelligence of school children was made in 1908 by the French psychologist, Alfred Binet, who, in collaboration with his colleague, Dr. Simon, devised a series of mental tests appropriately graded according to the ages of the children. Since that time a good deal of similar work has been carried out by Dr. Terman in the United States, and Professor Cyril Burt in this country, and standardized tests suitable for the children in each country have been constructed, a separate series of tests being devised for children of each year of age.

These tests have been designed for the purpose of determining the ability to use the knowledge which average children automatically acquire in an ordinary environment, irrespective of any education they may have received. They include tests of memory, knowledge of familiar things, the recognition of resemblances, and differences between common objects, judgment, reasoning, the detection of absurdities, the power of description of standardized pictures, etc. During the carrying out of these tests the confidence of the child must be secured, otherwise no reliable conclusions can be drawn from the responses to the tests.

The tests have been standardized by experimenting with large numbers of normal children in each age group, the tests for each particular age group being so devised that the average child of that group will earn full marks. Thus, for example, an average child of eight years of age should pass the eight-year-old tests, but would probably fail in the tests for the nine-year-olds. Such a child would be regarded as having a mental age of eight. Should, however, a child of ten only succeed in passing the eight-years test, he is also recorded as having a mental age of eight.

The mental age, taken into consideration with the child's chronological age, gives an indication as to whether a child is bright, dull, or mentally defective, and this relationship or ratio is spoken of as the *Intelligence Quotient* (I.Q.) or *Mental Ratio* (M.R.) which for convenience is recorded on a percentage basis, the mental age being divided by the chronological age and multiplied by 100. Thus, for example, in the above, the ten-year-old child whose mental age was that of eight years; would have an I.Q. of $\frac{8}{10} \times 100 = 80$.

The following table, based on Burt's classification, gives the approximate I.Q.s for the different grades of mentality, together with the percentage distribution of the persons in these grades :—

I.Q.	Grade of Mentality.	Percentage Distribution.
Over 150	Superlative	2
130 to 150	Very superior	2
115 to 130	Superior	10
85 to 115	Average	70
70 to 85	Dull	10
50 to 70	Feeble-minded	1 to 2
Under 50	Imbeciles and Idiots	2

There is, however, no hard and fast line of demarcation between adjacent groups, as, for example, between the normal and the dull or the dull and the feeble-minded, each group merging imperceptibly into the group above or below.

Because the above figures have been given, it must not be thought that the decision as to a child's mentality is made solely by ascertaining the child's I.Q.

The experienced examiner is also observant of the general attitude and behaviour of the child, and the manner in which he answers questions, and how he attempts to solve problems.

For example, if a normal child of ten be asked to arrange in order of weight some pill-boxes of similar size and appearance but of different weights, he would almost certainly pick them up in turn in order to contrast the weight of the different boxes before deciding which is the heaviest, and after provisionally placing them in their order, would again check them by comparing each adjacent pair before finally submitting the solution. Most defectives would pick up the boxes haphazard, and, with little or no intelligent attempt to compare their weights, place them in a row in any order.

In this test, although a child may not succeed in getting them all in the correct order, some credit is given if the child attempts the test in an intelligent manner.

Quite apart from the above tests there are also other matters which have to be taken into account, and it is only after weighing up all the information obtained from the several sources that a proper decision can be arrived at. The other matters to be taken into consideration include information regarding the child's habits, character, and disposition; and if the child has attended school, a report from the head teacher of the child's educational attainments and behaviour is also of considerable value. Information is also required concerning the family history and the child's history from birth, including information as to illnesses, the age of teething, walking, etc.

There are certain stages in a normal child's development which should be reached at more or less definite ages, such as the following: the cutting of the first teeth at about six months, sitting up at the age of nine months, and beginning to talk and walk between that age and fifteen months. Control of the bowels is usually obtained at about the age of fifteen months, and of the bladder at approximately two years of age, and the normal child is usually learning to dress himself and put on his shoes at the age of three. It is characteristic of mentally defective children that they take a longer time in arriving at these stages of development.

Along with the slow development of their mentality, many of the cases present also some evidence of a subnormal physical condition, thus, they may be undersized, or have feeble circulation, whilst they are more prone to chilblains and sores in winter. Occasionally certain so-called stigmata of degeneration are found, such as abnormal shape of the ears, epicanthus (a fold of skin at the inner angle of the eye), high arching of the palate, want of symmetry of the two sides of the skull, webbing of the toes or fingers, coarseness of the skin, etc.

The lack of nervous and muscular control is shown by the clumsy gait and bad posture which they usually adopt. Many of the children are of a phlegmatic type, being heavy and stolid in all their movements.

FEEBLE-MINDED CHILDREN

ONE of the mental characteristics of feeble-minded children is their incapacity to give their voluntary attention to anything for more than a brief period : their minds wander quickly from one thing to another, and consequently the difficulty of educating them is increased. Their memories, which are naturally poor, are still further handicapped by this inability to concentrate. Some of them possess a certain amount of rote or mechanical memory of things taught, in consequence of which parents may think that there is not much wrong with them. They are much less able than the average child to see logical connections between facts, and to put into practical application what has been memorized, thus, though able to repeat, parrot-fashion, simple multiplication tables, they may fail in doing easy problem sums.

The discovery of feeble-minded children rests largely with the teachers, who should draw the special attention of the school medical officers to any children who, in their opinion, are of poor mentality. Speaking generally, it may be stated that any child who is two or three years retarded from the educational standpoint and is not receiving proper benefit from education in the ordinary school, should be considered by the teacher as a possible mental defective and submitted to the school medical officer for examination.

The Board of Education require that children, before they can be admitted to special schools for the mentally defective, must be certified as feeble-minded by medical practitioners with a special knowledge of mental deficiency, approved by the Board, and termed Certifying Officers. After admission to a special school the children are required to be examined annually by the certifying officer with a view to deciding whether they are still suitable for such special education.

The children are retained in these schools until the age of sixteen, and prior to leaving, their mental condition is again considered by the certifying officer, who will cancel the certificate if he thinks that after leaving school the child will not require care, supervision, and control. If, however, such be considered necessary on leaving school, either for the child's own protection or for the protection of others, this must be reported to a special authority, known as the Local Mental Deficiency Authority, whose duty it then becomes to provide the necessary supervision.

EDUCATION OF FEEBLE-MINDED CHILDREN in the special schools aims, not at improving their intelligence, for no amount of education can accomplish this, but at developing to the utmost such mental powers as they possess, and also teaching them to comply with the recognized social conventions.

The mentality of the younger children in the special schools for the mentally defective is only on a level with that of nursery school children, and the mentality of the oldest of these children only equal to that of normal children of nine or ten years of age, and their annual rate of progress in school is little more than half that of normal children. In order that the children may be given more individual attention, not more than an average attendance of twenty-five is permitted for each class.

As feeble-minded children are considerably lacking in understanding, their education must be conducted on practical rather than on academic lines, and the subjects taught should, as far as possible, be connected with the practical needs of life, thus, in the case of reading, the value of reading street and shop names, public notices, news, etc., might be emphasized, and an endeavour made to get them interested in reading books as an occupation for their leisure time. Arithmetic lessons should be restricted to such matters as the weighing, measuring, and counting involved in everyday household and workshop experience.

Handwork is given a prominent place in the curriculum, and it is important that the work undertaken should have some immediate value to the children carrying it out, as thereby interest, which is fundamental to all learning and not easily created in their case, is aroused. Moreover, the degree of success of their finished products provides a useful means of educating them in the making of practical judgments. For example, if a table has been made which is found to be unstable on its legs, judgment is required to determine the cause of the instability and how to remedy it.

Sense training is of particular importance, and this can best be done in the case of the younger children by means of Montessori apparatus, constructive play with bricks, plasticine modelling, paper working, bead threading, etc., leading subsequently on to cardboard modelling, toymaking, basket and leather work, knitting and sewing. In the case of the older boys, from about the age of twelve onwards, more vocational work is undertaken, such as woodwork of a heavier type, tool repairing, metal work, tailoring, etc., while the girls receive special training in homecraft and needlework.

The vocational crafts taught should be those which will be most useful to the children later in helping them to secure local employment.

Social training is of considerable importance, and the younger children must be drilled into habits of tidiness and cleanliness and respect for the property of others. The older children should be given responsibilities and opportunities for practical helpfulness, in such a way that they will consider it as the ordinary behaviour of life and not special behaviour for the classroom.

The more such everyday co-operative work can be taught the better will be the general behaviour and response in later life. Such activities as the Girl Guide and Boy Scout movements are most helpful in character training, the children feeling that they are members of a select community to whose standards of conduct they are expected to conform.

In 1924 a joint committee, known as the Mental Deficiency Committee, was appointed by the Board of Education and the Board of Control to consider the whole question of mental deficiency. The report of this committee was issued in 1929, and amongst their various recommendations with regard to children they suggested :—

(1) That all the children hitherto classified as educable mentally defective, dull or backward, should be regarded as a single educational and administrative unit, and termed the " Retarded " group, and that these children should be retained within the public elementary school system, the organisation of the schools being modified so as to provide suitable education for the whole group of these children.

This suggestion, if put into force, would probably overcome the opposition of many parents who resent their children being admitted to special schools, because they feel that a certain stigma is attached to children educated in such schools.

(2) That the certification of children as mentally defective by the local authority should no longer be required in order to provide the children with the special education necessary, though the power should be retained to enforce attendance at whatever school is best suited to their educational capacity.

IMBECILES AND IDIOTS

FIG. 75. *An Imbecile* (mental age about 3½ years).

(Photo kindly supplied by Dr. F. A. Gill.)

IMBECILES and Idiots, the definitions of which were given on page 300, are the lowest types of mental defectives, of whom, fortunately, they form only a small proportion. Little need be said about them here, as they are quite incapable of being educated, even in the special schools.

IMBECILES may be either of a stolid or of an excitable type, the latter never keeping still for a moment, constantly chattering, running about and exhausting the patience of everybody. Educationally, imbeciles can usually only be taught a few words of two or three letters and to do the very simplest arithmetical calculations, though they never succeed in attaining even to the standard of a young infants' class. They may, however, often be taught simple manual occupation, such as rug-making or raffia work, such training having a marked effect in improving their habits and behaviour.

In adult life they are quite incapable of earning sufficient money to keep themselves, though they can be trained to do simple tasks, such as sweeping, dusting, etc.

One particular type of imbecile is known as the Mongol, because of the close facial resemblance to members of the Mongolian races. The eyes are close together and set obliquely and the nose is snubbed. In infancy, the tongue is often protruded, as though it were too large for the mouth,

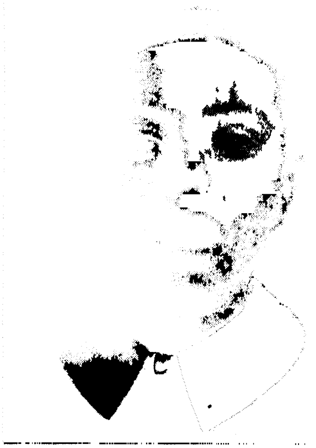


FIG. 76. *A Mongolian type of Imbecile.*

(Photo kindly supplied by Dr Dingwall Fordyce)

and its surface usually shows marked transverse fissures. The hands are stumpy and clumsy looking. In disposition such children are lively and affectionate, and they are usually imitative and fond of rhythmic musical noises. They are delicate in health and easily susceptible to catarrhal affections and often die about puberty.

Under the Mental Deficiency Act imbeciles have to be certified and reported to the Local Mental Deficiency Authority, whose duty it is to provide, both for imbeciles and idiots, whatever institutional accommodation may be required, or any guardianship or supervision considered advisable. Some of these authorities have provided "Occupation Centres" for imbeciles, where they receive habit training and are taught simple manual occupations.

IDIOTS are quite incapable of any education, and their deficiency is so pronounced that they can seldom be trained to be clean in their habits, to dress or even to feed themselves. They understand only the simplest words, and a few simple commands such as "sit down." Their speech is limited to a few monosyllables and the mechanical repetition of a few words and syllables after another person (*echolalia*)

Unable to do any kind of work, they have to be looked after, dressed, washed, etc., all their lives with the care that has to be given to an infant. They are usually destructive, and lacking even in the primitive instinct of self-preservation.

MORAL DEFECTIVES

MORAL DEFECTIVES, as defined in the Mental Deficiency Act, 1927, are persons "in whose case there exists mental defectiveness coupled with strong vicious or criminal propensities, and who require care, supervision, and control for the protection of others."

From this definition it would appear that, however strong may be a person's vicious or criminal tendencies, he cannot be certified as a moral defective unless he is also feeble-minded. But many, if not most, of the children with such propensities, when subjected to the Binet and Simon tests, or other similar tests for intelligence, show little or no evidence of defectiveness, in other words, their I.Q. may be average or even above the average.

FIG. 77. *An Idiot* (mental age less than 3 years).

(Photo kindly supplied by Dr F. A. Gill)

It will thus be seen that, except in rare instances, it is a very difficult matter for a Certifying Officer to satisfy himself that cases, which on account of serious moral defect he considers ought to be under control, come within the legal definition of the Act. Speaking generally, in physique, appearance and educational attainments, morally defective children differ in no way from the normal.

Usually the first signs such children exhibit are those of petty thefts, lying, and cruelty to other children and animals, and some frequently wander from home. Other conspicuous signs are: excessive selfishness, ingratitude, and utter lack of shame, of remorse, or of affection for their parents, even when they are quite young children. These children are often quite attractive and have engaging manners, though really they are sly and cunning, with the result that teachers and others are completely thrown off their guard, and until actually caught in some wrongdoing they often succeed in carrying out their misdeeds for a long time without being found out. As examples of their cruelty may be given the case of a boy who put a cat on the fire, another who set fire to a building, and when caught gave as an explanation that he thought it would be "fun" to see people burning, and another who "for fun" held a younger child's head under water until he was drowned.

The outlook in the case of moral defectives is extremely bad, and the best thing for all concerned is for such children to be put under permanent control in a residential institution, if they can be legally certified.

With the establishment of child guidance clinics it has become, quite rightly, the practice to refer to them cases of delinquency, such as truancy, pilfering, etc. When such delinquencies are found to be due to social or environmental causes, the results of treatment at the clinics are often successful, but when such delinquencies are found to be the practical manifestations of the mind of a moral defective, they are not cases which would derive any benefit from treatment at a child guidance clinic. The only faint hope in their treatment is to deal with them by a system of reward and punishment. As they are extremely selfish, it is just possible that in some cases they might be kept in check a little by bribery and fear, but it is quite useless to reason with them, as they are devoid of all honour or sentiment.

THE DULL AND THE BACKWARD

THERE is considerable confusion as to what exactly is meant by backward children and dull children, and the children of either type are frequently spoken of indiscriminately as dull and backward children, a term which suggests that backwardness is always associated with dullness and *vice versâ.* There is, however, an essential difference between the two, dull children being those whose intelligence is definitely below normal, but not to such a degree as to warrant classification as feeble-minded, whereas backward children are possessed of normal intelligence, but have not had sufficient opportunity of acquiring the average scholastic attainments of normal children of the same age.

Dullness is of a permanent nature and, in the great majority of the cases, is attributable to congenital mental causes, but *backwardness* is not innate and is capable of remedy.

The brain of the dull child probably contains fewer of the nerve cells concerned with the higher intellectual functions, and the functioning of the cerebral reflexes is less efficient than in the case of the normal child.

The resultant mental impairment, however, is not of sufficient degree to justify the child being regarded as feeble-minded.

Regarded solely from the point of view of the Intelligence Quotient, it will usually be found that in the case of a dull child the I.Q. is between seventy and eighty-five.

In the case of the backward child, the cerebral nerve cells and connecting fibres are normal in number and fundamentally sound, but are not as fully developed as they are capable of being, owing to defective stimulation or nourishment, which results from certain physical or educational handicaps, temperamental defects, or unsatisfactory environmental conditions.

Amongst the physical causes the following are the most important : defective eyesight or hearing, malnutrition, poor health, enlarged tonsils and adenoids, and fatigue due to insufficient sleep or other causes.

Educational causes include late admission to, prolonged absences from, or frequent changes of school, and also ineffective teaching.

According to Sir George Newman, over 10 per cent. of the children in the public elementary schools are dull or backward, 6 per cent. being dull and 4 per cent. backward.

The presence of this undue proportion of the dull and the backward children in the ordinary classes of the public elementary schools is inconsistent with the best interests of education, for clearly, considering the large size of the classes, teachers cannot be expected to give the necessary individual attention to such children to the neglect of the much larger number of children who are normal. Consequently, many children leave school each year who cannot be considered to have obtained full benefit from their education.

As the dull and the backward children possess the potentiality, under favourable educational conditions, of developing into useful, self-supporting members of the community, the need for affording them appropriate education is perhaps more important than the provision of special education for the mentally defectives.

The sooner dullness and backwardness are recognized and suitable education, and treatment also, where necessary, provided, the better for the children concerned.

In certain areas where there are some large schools, the head teachers themselves arrange for the formation of smaller classes in which such children can receive more individual attention, but how best to arrange for a comprehensive scheme applicable throughout the country is a matter that has not yet been decided upon by educationists.

The Nottingham Education Authority is a pioneer in this direction, having put into operation the following scheme :—

On attaining the age of seven all children are required to be subjected by the head teachers to certain standardized arithmetical and reading tests of a simple nature, which are partly tests of education, and partly of intelligence. The result of these tests is expressed as a percentage known as the Educational Ratio (E.R.). The age of seven for testing has been chosen because at that age most of the children will not only have received a certain amount of education, but also have been under the trained observation of the teachers for some time.

One of the school medical officers visits the school and discusses with the head teacher the cases of those children whose E.R. comes below 90 per cent., and makes a preliminary investigation of the intelligence of each of these children. He selects suitable cases for a physical and a more detailed mental examination by a senior school medical officer. At this examination the parents are invited to be present.

If any of the children are found to have defects of sight or hearing they are referred to the eye and ear specialists for their opinion and advice. In the case of delicate children, it may be considered advisable for them to be educated at an open-air school.

If a child is mentally defective he is certified as such, and is required to attend for education at a day special school. For the dull and the backward, special classes have been arranged in the ordinary schools. With reference to these special classes Dr. Newth, the Nottingham School Medical Officer, writes :—

" The education of the backward and the dull, we believe, should be carried out in special classes in the ordinary senior schools. The children would thus mix in their games with children of their own age and of superior intelligence. Some euphemistic title should be found for these classes, so as to avoid even the impression of inferiority. The teacher should be one of long experience and exceptional skill. The classes must be much smaller than the ordinary classes. We understand that where these classes have been established in Nottingham they have proved a great help, not only to the backward and dull children, but also to the teachers, thus indirectly benefiting the normal children. The advantages of such classes are :—

" They relieve the ordinary class teacher of the children who are such a drag on his energies.

" They allow the special class teacher to concentrate on the general or particular defect which is keeping the child back.

" They afford the dull children a scope for their restricted abilities, and prevent them from drifting into permanent occupation of the lowest places of the normal classes.

" They act as a most valuable testing-ground for the border-line mentally defective cases before transference to a special school."

CHAPTER 23

THE SCHOOL MEDICAL SERVICE

Statutory powers and duties. Objects and outline of scheme of the service. Methods of " following up." Schemes of treatment, clinics, etc. Employment of children and young persons.

THE establishment of the School Medical Service was the outcome of the publication of the Reports of the Royal Commission on Physical Training (Scotland), and the Interdepartmental Committee on Physical Deterioration, which were published in 1903 and 1904 respectively. Both of these Reports drew attention to the serious condition of the physique of numbers of school children, and the latter Committee urged that steps should be taken to forestall the ravages of disease so manifest in the adolescents. As a consequence, a section was included in the Education (Administrative Provisions) Act, 1907, which made it compulsory for every local education authority to inaugurate a system of medical inspection of children attending the public elementary schools in their area.

Later, the Education Act of 1918 extended the scope of the school medical service to include also the pupils attending secondary schools provided by local authorities. The provisions in the two Acts, slightly modified, were included in the consolidating Education Act of 1921, in which Sections 80 and 81 impose on local education authorities the duty of making arrangements for the medical inspection of children attending the public elementary schools on their admission and on such other occasions as the Minister of Health may direct, and also the duty of making suitable arrangements for attending to the health and physical conditions of the children. For any treatment provided under these arrangements the parents must be charged, if their financial circumstances permit. It is important to note that under this Act, no obligation is imposed on a parent to submit his child to medical inspection or treatment.

In the exercise of his powers under this Act, the Minister of Health has directed that in addition to the examination of the children on their admission to the public elementary schools (entrants), there shall be a full "routine" examination of the children at the age of 8 and again at the age of 12. The children in these groups are referred to as "intermediates" and "leavers" respectively.

So far as the higher schools are concerned, Section 80 of the Act makes it the *duty* of local education authorities for higher education to provide for the medical inspection of children and young persons attending secondary and continuation schools, etc., provided by them, and also gives the *power* to make arrangements for attending to their health and physical condition.

Power is also given to local authorities to include within their scheme pupils attending higher schools or educational institutions under voluntary management, if so requested by the managers of such schools or institutions.

The Minister of Health has laid it down that the pupils shall be medically inspected on admission, again at the age of 12, and thereafter annually.

Under the Ministry of Health Act, 1919, the powers and duties of the Board of Education, as far as the school medical work was concerned, were transferred to the Minister of Health, but the supervision of this work has not yet been taken over by the Minister and still remains under the Board of Education.

Whilst the general principles on which the school medical service should be conducted have been laid down by the Board of Education, the method of putting them into practical application is largely left to the respective education authorities, in order that they may be carried out in the manner most suited to particular local requirements.

The School Medical Officer of each area is usually also the local Medical Officer of Health, but in some areas he is an independent officer. He is provided with such assistant medical, dental and specialist officers as the size and requirements of the area may necessitate. School nurses or health visitors are also appointed to assist the doctors at the inspections in the schools, and in carrying out the treatment at the clinics, to carry out the work of "following up" at the homes, and to deal with children who are unclean or neglected. The administration of the work is carried out at the central office of the School Medical Officer. There, also, are prepared all the necessary statistical returns required by the local education authority and the Board of Education, for whose information the School Medical Officer is required to submit an annual report.

At the routine medical examinations, to which the parents should always be invited, full records are made of each child's physical condition. The parents are advised of the existence of any defects which may require treatment, and told how this can best be obtained, and the children concerned are subsequently kept under regular medical supervision until the defects have been remedied. These children are re-examined approximately twice each year, but more frequently if necessary. On any occasion that the medical officer visits a school he will, at the request of teachers or parents, see any children other than the routine or re-inspection cases, such cases being spoken of as "special cases."

The proportion of children found at the routine inspections to be suffering from definite physical defects, requiring either treatment or to be kept under observation, is approximately 20 per cent., if dental defects, which are very common, be excluded. By far the most frequent of these physical defects are defective sight and enlarged tonsils and adenoids ;

less frequent are cases of skin disease, malnutrition, deformities, ear defects, nervous defects, and heart or respiratory conditions.

As the result of experience it was found that the mere notification to parents that their children had certain defects which were in need of treatment was not always sufficient to induce parents to secure the treatment necessary for their children. Accordingly, methods of " following up " were devised with the object of having the parents visited at their homes and the nature of the defects explained to them, the necessity for treatment urged, and advice given to them as to the best manner of obtaining such treatment. This " following up " is usually done either by school nurses or by members of Care Committees.

Care Committees were originally organized to assist in the carrying out of the Education (Provision of Meals) Act, 1907, which was passed with the object of giving authorities power to provide meals for children who were unable to benefit properly from their education owing to lack of sufficient food. Later, these Committees extended their activities to include matters associated with medical treatment, and the provision of boots, clothing, etc., for children. In areas where these Committees are in existence, it is customary for each school to have its own Committee, the membership of which usually comprises some of the managers of the school together with other voluntary workers. One of the Committee members is usually present when the medical examination of the children is in progress, and makes notes of any advice given by the doctor, and subsequently visits the homes to see if such advice has been acted upon.

Care Committee members should be in touch with the various treatment schemes and social agencies available in the district, in order that when visiting the homes, they may be able to tell the parents how best to obtain the treatment recommended, and advise them concerning any difficulties with which the families may be faced. The more progressive

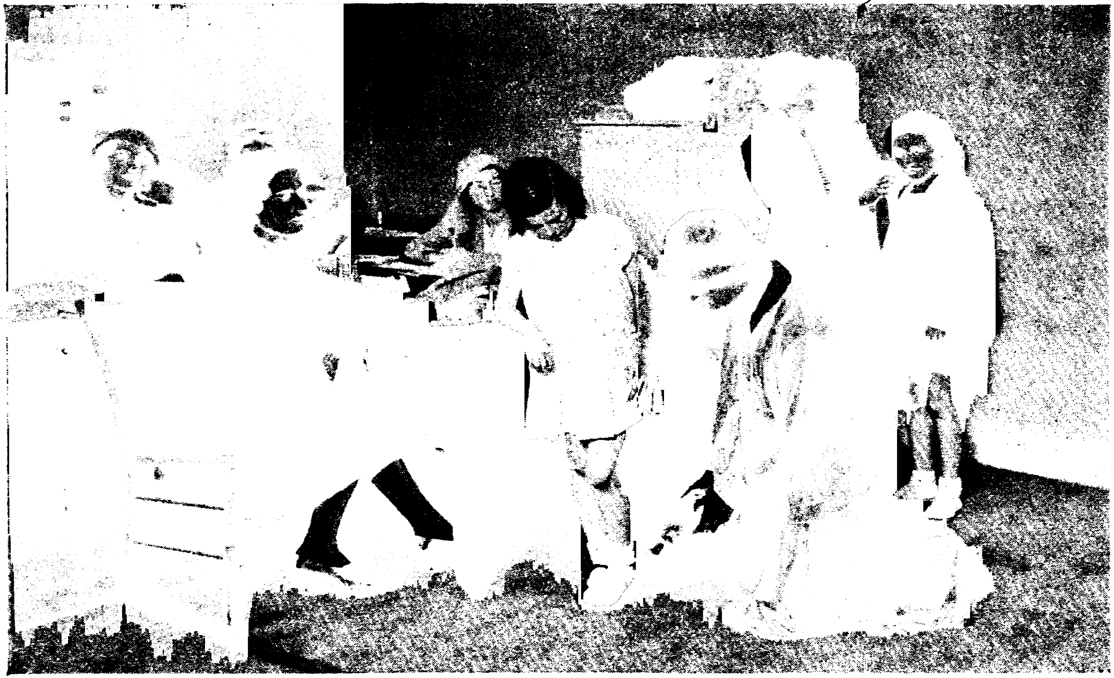


FIG. 78. *Care Committee Members providing Shoes and Clothing for poor children.*
(From "The Schools at Work," by permission of Messrs. Evans Bros.)

Care Committees interest themselves also in children's clubs, and in the provision of recreation facilities for the children out of school hours.

In the case of children with disabilities causing suffering or injury to health, such as deformities or serious cases of defective vision, where the parents, either through ignorance or indifference, fail to secure treatment, legal proceedings for neglect may be taken against the parents under Section 1 of the Children and Young Persons Act, 1933.

This section makes it a misdemeanour, punishable by imprisonment or fine, for any person who has attained the age of sixteen to assault, ill-treat, neglect or abandon in a manner likely to cause unnecessary suffering or injury to health, any person under the age of 16 under his care. Failure to provide adequate food, clothing, or medical aid, is deemed to be neglect within the meaning of this section.

The Board of Education requires local education authorities, as a minimum, to make provision for the treatment of the following defects : enlarged tonsils and adenoids, defective eyesight, dental defects and minor ailments—a term which includes such conditions as skin diseases, inflamed eyes, discharging ears, etc. In addition to this minimum, many of the more progressive authorities have made provision for the treatment of other conditions, such as orthopædic defects, anæmia and debility, etc.

With the approval of the Board of Education, arrangements are sometimes made, particularly in the county areas, with hospitals or voluntary associations, to provide treatment for certain defects, but usually the authority itself provides special treatment clinics. In the smaller towns, one central clinic with facilities for the treatment of the various types of defects is often sufficient. In the larger towns and county areas, however, several clinics are usually necessary, so distributed as to be situated within easy access of the schools and homes of the children. In some cases, clinic premises in which treatment for several types

FIG. 79. *A Combined School Clinic and Child Welfare Clinic.*
(By permission of the 'Liverpool Express')

of defect can be carried out are specially built; in other instances, an existing building, such as a house, a disused school or hall is adapted for the purpose, or a church hall rented.

The Board of Education permits any time spent at any of these clinics for treatment, to be counted for the purposes of the Government Grant, as time spent in attendance at school, and in order to claim grants for such attendances the Board's regulations lay down that the times of arrival and departure of the children should be recorded in registers kept at the clinics for this purpose.

The following is a brief description of the more important types of school clinics :—

Minor Ailments Clinics. At these clinics are treated such conditions as cuts, septic sores and abrasions, impetigo and other skin conditions, discharging ears and inflammatory eye conditions. Such communicable skin conditions as ringworm, scabies, and pediculosis are better treated at separate clinics.

The accommodation required for such a clinic is a waiting room, a room in which the treatment is carried out by the nurse, and a smaller room in which the doctor in charge can examine the children.

The object of these clinics is to provide early and regular treatment in order to prevent minor ailments from developing into major conditions. In this connection, it has been observed that since the opening of these clinics in Liverpool the number of cases of corneal ulceration, which formerly often resulted in a serious impairment of vision, has greatly diminished both in frequency and severity. Other advantages of these clinics are that the necessity for excluding children from school is often obviated, and children absent from school on account of minor ailments are rendered fit to return to school earlier than would otherwise be the case.

Defective Vision Clinic. The premises required for one of these clinics include a waiting room, an examination room, and a small dark room fitted with a special lamp, where the specialist can examine the eyes after their pupils have been dilated by special drops or ointment. In the case of children, it is only by such examination that the nature and the amount of the defect can be accurately ascertained and suitable lenses prescribed.

In most areas this work is undertaken by specialist medical officers, but in certain areas school medical officers who have had special experience of eye work do the routine work, referring the more difficult cases for examination by a specialist. Arrangements are also made with opticians to make up the glasses prescribed, and also, if necessary, later to repair them at contract prices. Before the spectacles are given to the children, it is important that the medical officer should ascertain that the lenses have been made up accurately in accordance with the prescription and that the frames are a suitable fit.

FIG. 80. *A School Clinic for the treatment of minor ailments.*
(Photo kindly supplied by the Medical Officer of Health, Birkenhead.)

As, with growth, the shape of the eye changes, it is very desirable that the cases should be re-examined from time to time at the clinic, in order to see if any alteration of the spectacles is necessary. The intervals between such re-examinations depends upon the type and severity of the defects.

Examination at the clinics brings to light certain cases, such as those of high myopia, in which the continuance of the ordinary school work would be too great a strain, and for which certain precautions are necessary in order to prevent the defect from progressing. Printed instructions in these cases should be given to the parents, and the teachers should be informed of the precautions advised. The more severe cases are referred for admission to classes for the partially sighted or schools for the blind.

Tonsils and Adenoids Clinic. The accommodation required comprises a waiting room, an operating theatre and a recovery room, or preferably a ward, since it is most desirable that after the operation the children should be retained under supervision for one or more nights.

Both verbal and printed advice regarding the after-care of the cases should be given to the parents, but experience has shown that the advice given is not always carried out, and it is, therefore, advisable that each child should, for a few days after returning home, be occasionally visited by a nurse in order to see that the advice is being carried out and satisfactory progress is being made.

Dental Clinics. A dental clinic should include a waiting room, a surgery, preferably with a north light, and a recovery room, fitted with a sink and a supply of hot and cold water, where the children can rinse their mouths after operation.

A dental attendant should be present to assist in the management of the children, the preparation of materials for the dentist, filing cards, etc. A special chart of each child's teeth is kept at the clinic, on which is marked the treatment carried out at each visit.

Orthopædic Clinics. The accommodation required includes

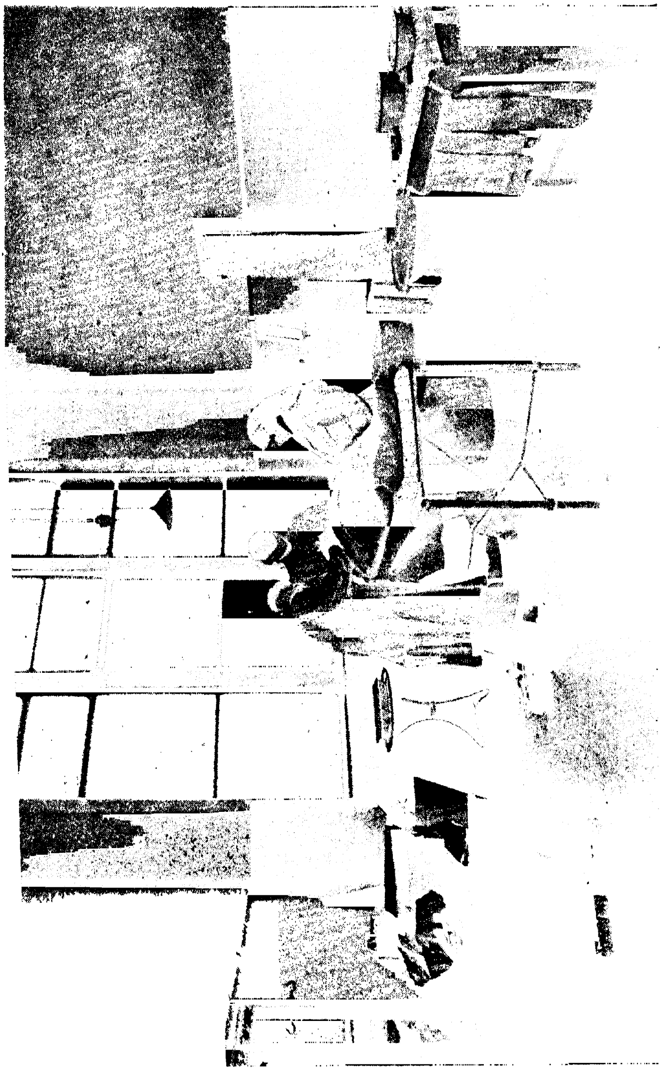


FIG. 81. *The Operating Room at a Tonsils and Adenoids Clinic.*

a small consulting room, in addition to a waiting room, and a treatment room where remedial exercises and massage can be carried out by the masseuse. The application of plaster of Paris bandages can often be advantageously carried out at these clinics, and the addition of a small "plaster room" is useful when this work is done. The treatment room should be equipped with suitable couches on which the patients can recline when undergoing massage, and certain forms of gymnastic apparatus are also necessary, such as wall-ladders, a boom for the treatment of spinal curvature cases, and a balancing-bench for the re-education of leg muscles. Some electrical apparatus is desirable, such as radiant heat baths and Galvanic and Faradic currents, which are used for diagnostic and treatment purposes respectively (see page 259).

Certain of the larger authorities also provide clinics for the treatment of other defects, such as :—

(*a*) *X-ray Clinic*, for the treatment of ringworm of the scalp.

(*b*) *Scabies Clinics*, equipped with baths and disinfecting apparatus. Such clinics are for the convenience of parents who have not the facilities for the efficient carrying out of the treatment at home.

(*c*) *Aural Clinics*. A considerable number of children suffer from discharging ears (*otorrhœa*), and this is often associated with deafness. The majority of these cases are treated at the minor ailments clinics, but some authorities have provided special clinics at which electrical treatment, known as Zinc Ionisation, can be carried out (see page 189).

At an aural clinic, cases of deafness thought to be suitable for education at a school for the deaf, or at classes for the partially deaf, can be examined by the doctor in charge, with a view to ascertaining his opinion as to the most suitable type of education for them.

(*d*) *Light Clinics*, for treatment of anæmia and debility and rickets by means of ultra-violet rays (see page 63).

(*e*) *Cleansing Stations* are premises provided with one or more slipper-baths, wash bowls and a disinfector, to which children whose heads or clothing are verminous may be taken for cleansing. A clinic attendant is usually in charge and she undertakes the cleansing, but when the parent is present, the attendant should require her to effect the cleansing under supervision. Whilst the child is being bathed the clothing is treated in the disinfector.

The accompanying diagram (page 343) shows the more important branches of the work of a comprehensive School Medical Service, and how most of the defects discovered can be dealt with.

The following items shown in the diagram with which the School Medical Service deals are referred to in detail elsewhere :—

(1) References of suitable cases to be dealt with under the Provision of Meals Section of the Education Act, 1921, (Sections 82-85) (see page 228).

(2) Selection of suitable cases for admission to special classes for speech defects, including stammering (see page 273).

(3) References of cases of " difficult " or " maladjusted " children for investigation at a Child Guidance Clinic (see page 293).

(4) Any cases of tuberculosis are notified to the Medical Officer of Health, whose responsibility it is to arrange for sanatorium or domiciliary treatment.

(5) Cases of infectious disease are also notified to the Medical Officer of Health, who arranges for admission to hospital when necessary and for the disinfection of the house. An outbreak of infectious disease in connection with a school may be dealt with either by the School Medical Officer or the Medical Officer of Health.

(6) Many authorities have made arrangements for the treatment of delicate children by providing day or residential open-air schools, and one or two authorities have also provided residential schools for rheumatic children. It

is the duty of the school medical officers to select cases suitable for admission to these schools (see pages 164 and 233).

Other types of delicate children who are in need of convalescent treatment are referred for such treatment when it is provided either by the authority or any voluntary association. Some authorities have also made provision for the supervision and treatment of rheumatic children at special rheumatic centres.

(7) It is the duty of the school medical officers to discover all the cases of physically and mentally defective children who should be educated in day or residential special schools (see pages 261 and 318).

The medical officers usually make an annual inspection with regard to the hygienic condition of the school premises and equipment, and if any action be considered necessary, reference is made to the appropriate quarter.

A good deal of research work and investigation into matters affecting the health of the school children has been carried out by various school medical officers throughout the country, and the Board of Education from time to time invites school medical officers in various areas to co-operate in team investigation. In this way much valuable information has been collected.

The School Medical Service is also concerned with the suitability of school children for employment and advising the Juvenile Employment Bureaus as to the best type of employment suitable for particular children on leaving school.

Section 18 of the Children and Young Persons Act 1933, which deals with the *employment of school children,* states that no child shall be employed :—

(*a*) So long as he is under the age of 12 years ; or

(*b*) Before the close of school hours on any day on which he is required to attend school ; or

(*c*) Before six o'clock in the morning or after eight o'clock in the evening on any day ; or

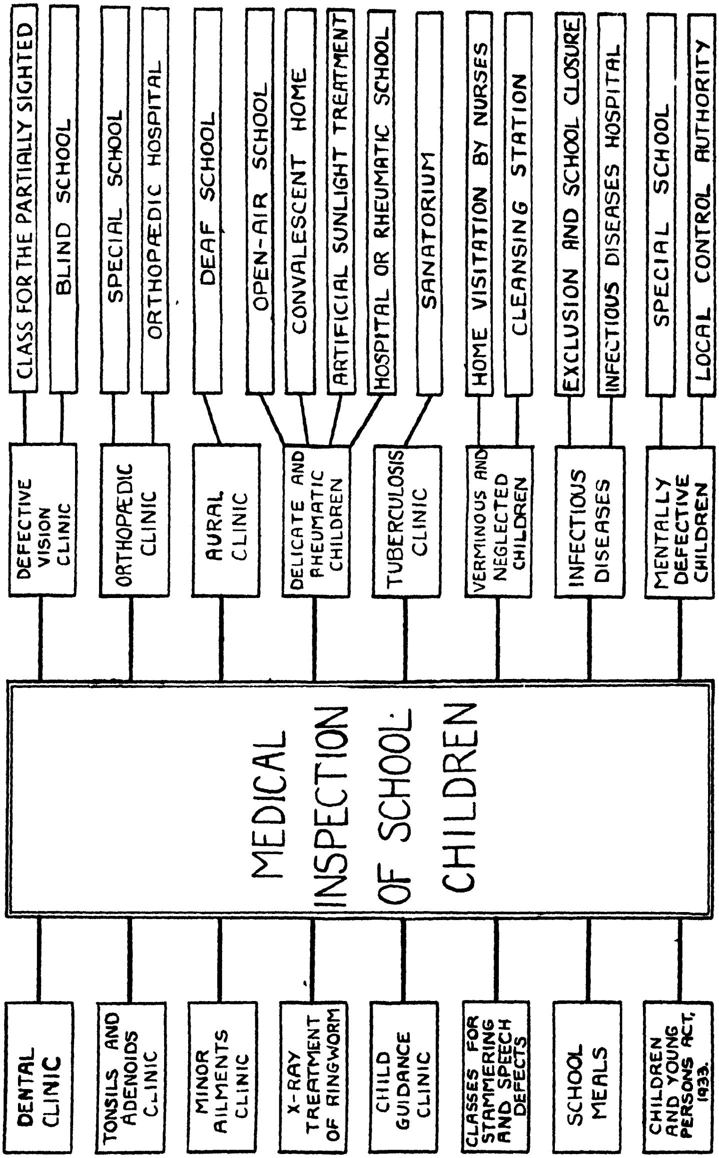

MEDICAL INSPECTION OF SCHOOL CHILDREN
DEFECTIVE VISION CLINIC
CLASS FOR THE PARTIALLY SIGHTED
BLIND SCHOOL
ORTHOPÆDIC CLINIC
SPECIAL SCHOOL
ORTHOPÆDIC HOSPITAL
AURAL CLINIC
DEAF SCHOOL
DELICATE AND RHEUMATIC CHILDREN
OPEN-AIR SCHOOL
CONVALESCENT HOME
ARTIFICIAL SUNLIGHT TREATMENT
HOSPITAL OR RHEUMATIC SCHOOL
TUBERCULOSIS CLINIC
SANATORIUM
VERMINOUS AND NEGLECTED CHILDREN
HOME VISITATION BY NURSES
CLEANSING STATION
INFECTIOUS DISEASES
EXCLUSION AND SCHOOL CLOSURE
INFECTIOUS DISEASES HOSPITAL
MENTALLY DEFECTIVE CHILDREN
SPECIAL SCHOOL
LOCAL CONTROL AUTHORITY
DENTAL CLINIC
TONSILS AND ADENOIDS CLINIC
MINOR AILMENTS CLINIC
X-RAY TREATMENT OF RINGWORM
CHILD GUIDANCE CLINIC
CLASSES FOR STAMMERING AND SPEECH DEFECTS
SCHOOL MEALS
CHILDREN AND YOUNG PERSONS ACT, 1933.

FIG. 82. *Schematic representation of Scope of Work of the School Medical Service.*

(*d*) For more than two hours on any day on which he is required to attend school , or

(*e*) For more than two hours on any Sunday ; or

(*f*) To lift, carry, or move anything so heavy as to be likely to cause injury to him

Local authorities are, however, empowered to make by-laws which may slightly modify the above provisions A number of authorities in their by-laws have laid down that all school children employed must be licensed by the authority, and that such licenses shall only be granted when a school medical officer has certified that the employment would not be prejudicial to the health of the children

Most education authorities have established a *Juvenile Employment Bureau* for the purpose of assisting children to secure suitable employment on leaving school, and the school medical staff can be of considerable assistance to such Bureaus in advising as to the physical capabilities of the children Some school medical departments arrange that at the last routine medical examination of the children the question as to their suitability for different types of employment must be considered and noted, as for example, their unsuitability for hard manual work, or for exposure to bad weather, or work in a dusty atmosphere, or work involving strain to eyes or ears When the children leave school, such information is forwarded to the Juvenile Employment Bureau.

The Unemployment Act, 1934, provides for the establishment of courses of instruction and training for unemployed boys and girls between the ages of 14 and 18, with the object of preventing their demoralization The National Advisory Council for Juvenile Employment set up by the Minister of Labour, in their Report in 1934, recommended that the services of the school doctors should be made available for boys and girls attending any Junior Instruction Centres established under the Act if they are not already eligible for treatment under the National Health Insurance Act.

CHAPTER 24

SCHOOL PREMISES

Progress in development. Methods of ventilation, lighting and heating schools. The classroom and its equipment, cloakrooms, lavatories, playgrounds, etc.

UP to the end of the nineteenth century the main consideration in the planning of school buildings was that of utility, little or no thought being given to the question of hygiene. During the present century considerable progress has been made in the planning of school buildings, but there are still in existence many schools of an old type which in the light of modern knowledge must be regarded as obsolete.

At one time many of the older schools were designed on an ecclesiastical style, with very large square classrooms, often having narrow windows of a semi-Gothic type. In these rooms several classes had to be taught simultaneously, though later most of these rooms were sub-divided by wooden or glazed partitions. The ventilation was poor and the heating was usually by open fireplaces, which made those near by uncomfortably hot, while children at a distance received no warmth at all. The classroom floors were frequently stepped, and in most of the schools there were to be found the long continuous desks, often with backless seats.

The artificial lighting was by means of flat-flamed gas burners, some of which were later replaced by incandescent burners. In the towns, the sites on which the schools were built were totally inadequate in size, so that often there was practically no playground accommodation, and the classrooms were often overshadowed by surrounding buildings.

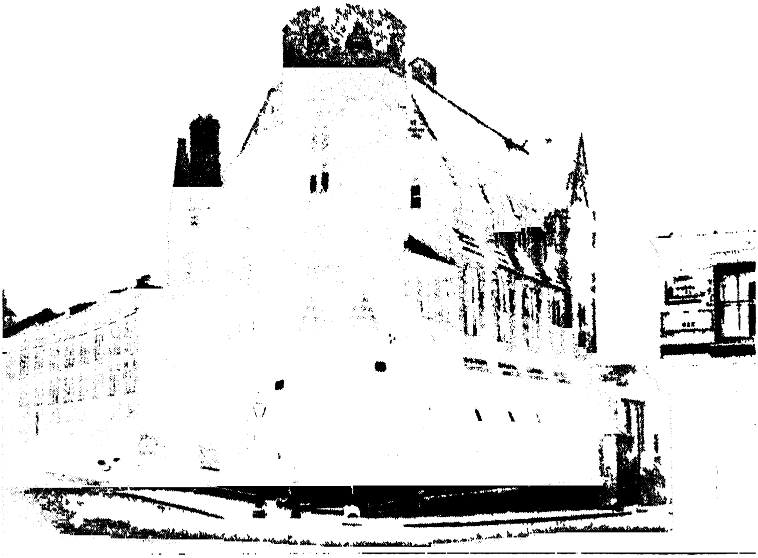


FIG. 83. *A former type of school building, showing semi-Gothic style of architecture.*

Cloakroom and lavatory accommodation were insufficient and the sanitary conveniences primitive. In the towns they were frequently of the trough closet type, and were not cleansed automatically but were dependent for cleanliness on the assiduity of the caretaker. In the rural schools the conveniences were of the privy-midden type.

At the end of the last century and at the beginning of the present, the school buildings erected were largely of the *Central Hall Type*, in which the classrooms were arranged around a central hall, which was used for the purpose of assembly, drill, etc.

With the successful introduction of mechanical ventilation for factories and workshops, it was thought that a purer atmosphere could be obtained in the schools by this method. In some of the new schools built on the central hall plan

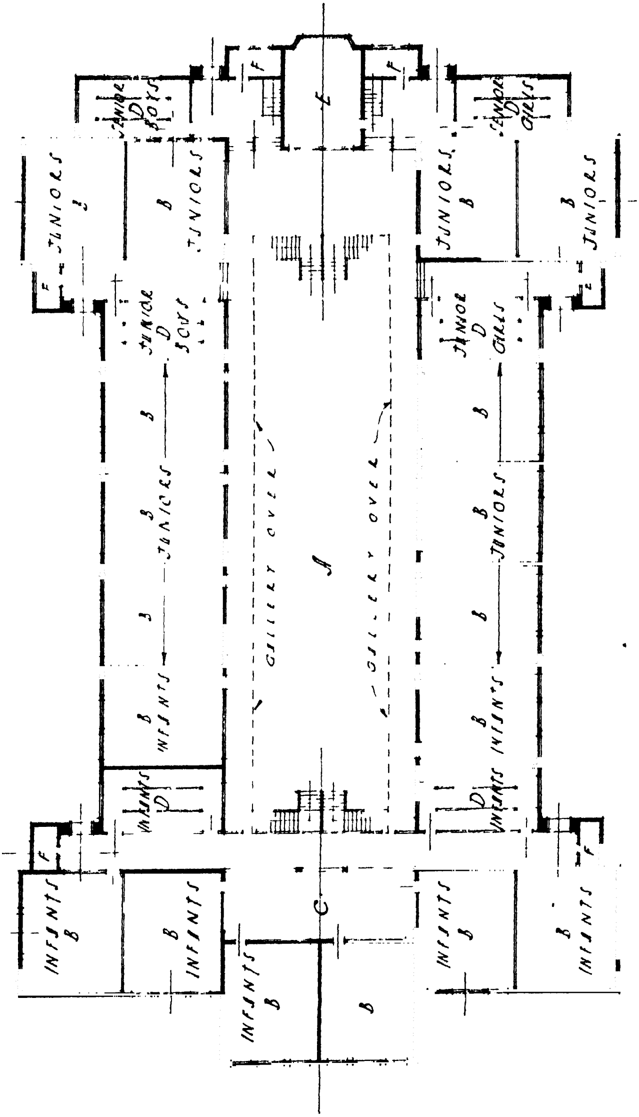


Fig. 84. *Plan of Central Hall Type of School.*

A. Central hall. B. Class room. C. Infants' marching space. D. Cloak room. E. Head teacher. F. Lavatories.

about the beginning of the present century, artificial ventilation was accordingly provided, either by means of the propulsion or " plenum system," the " extraction system," or a combination of both.

These mechanical methods of ventilation proved very expensive, not only to instal but also to maintain, and moreover, they did not prove very successful in securing the adequate ventilation of the schools anticipated. From the educational point of view the central hall type of school was not altogether satisfactory, owing to the fact that the occupants of the surrounding classrooms were seriously disturbed when the central hall was being used.

Objection was also taken to this type of school on health grounds, it being pointed out that in the case of those schools in which mechanical ventilation was not installed, efficient through ventilation of the classrooms was not possible. Fresh air entering through the outside windows of the rooms on one side of the building would, after having some of its freshness removed by passing through these classrooms, have to traverse the width of the central hall and then pass through the classrooms on the opposite side of the building before getting out into the open air.

To overcome these objections a new type of school building, which came to be known as the *Staffordshire Pavilion Type*, was designed by Dr. Reid, a former Medical Officer of Health of Staffordshire, in conjunction with the county architect. The classrooms were so arranged as to have windows on opposite sides opening directly into the open air, thereby providing direct cross ventilation through the rooms. At the bottom of these windows hopper ventilators were provided to deflect the incoming fresh air in an upward direction to prevent inconvenience to the occupants. On one side of the classrooms there was a verandah or fresh-air corridor. The assembly hall was not directly connected with the classrooms, and here also cross ventilation was arranged for.

The first Staffordshire Pavilion Type of school was opened

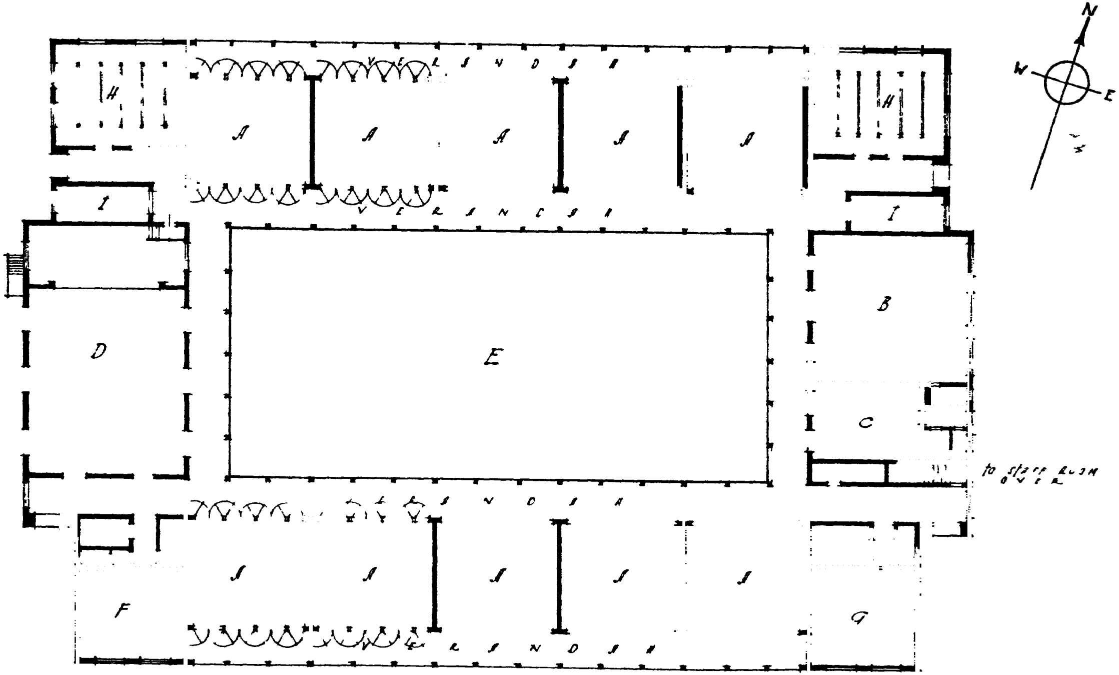


FIG. 85. *Plan of Department of Semi-open-air School of the Quadrangular Type.*
A. Class rooms. B Domestic science C. Special instruction. D. Assembly hall.
E. Quadrangle F Staff room. G. Medical inspection. H. Cloak room. I Lavatories

in 1907, and as a marked improvement in the health of the children resulted from their attendance at this experimental school, other authorities adopted the same type of building.

Further improvements in the cross-ventilated pavilion type of school followed, largely as the result of the pioneer work of Mr. Widdows, the architect of the Derbyshire County Council, who endeavoured in his designs to secure the maximum amount of ventilation in the classrooms without causing inconvenience to the occupants. This was achieved by building the rooms so that one or both sides could, by means of folding glazed doors, be partly or completely opened, according to the requirements of the weather conditions.

The present tendency is to erect new public elementary schools on such semi-open-air lines. Though the designs must of necessity differ according to local circumstances, such as the type of education to be provided, the amount of space available, the site, aspect, climatic conditions, and the cost of the land, the school buildings built are, generally speaking, either of the *Quadrangular Type* or the *Pavilion Type*. In the former type the buildings are arranged around a large quadrangle, with two sides longer than the others. In one form of this type of planning the classrooms are arranged along the two long sides, whilst on one of the short sides the assembly hall is located, and on the other, special instruction rooms. In another type, the assembly hall is placed across the centre of the main quadrangle, thus dividing it into two smaller quadrangles.

If sufficient land can be secured at a reasonable price to allow of the pavilion type of school with all the classrooms facing south, this type of building is probably preferable. The plan of such a building is shown in Fig. 86, in which all the classrooms face nearly south. The assembly hall is in the middle of the building, and a verandah is shown running along the whole length of the building on the north side. The pavilion type is usually a building of one storey,

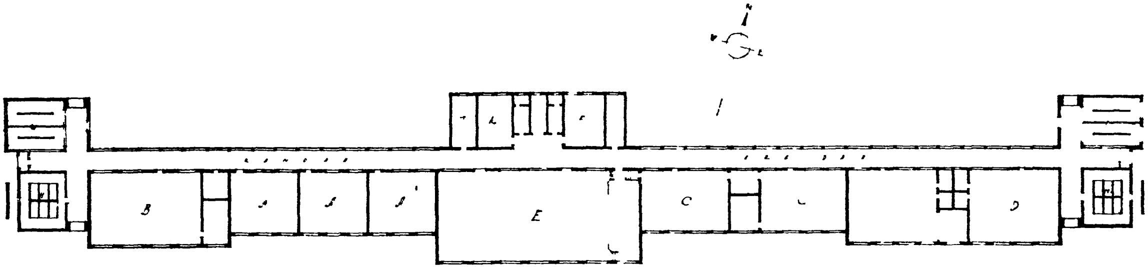


FIG. 86. *Plan of Department of Pavilion Type of School.*

A. Class rooms.
B. Science room.
C. Handicraft rooms, library and needlework.
D. Domestic science.
E. Assembly hall.
F. Staff rooms.
G. Cloak rooms.
H. Latrines.
I. Lavatories.
J. Store rooms.
K. Medical inspection room.

but two stories, or even three stories, may be provided in congested areas.

When Mr. Widdows first experimented in Derbyshire with the modern type of school building on semi-open-air lines, he considered it desirable to arrange for an open corridor or verandah on two opposite sides of the classrooms. These corridors or verandahs sometimes had glazed roofs. As the verandahs cut off a certain amount of the lighting, he provided for some supplementary lighting by building the roofs of his classrooms on the Mansard type, which has a roof with two slopes at different angles, and he arranged that the lower slope on the north side should be glazed.

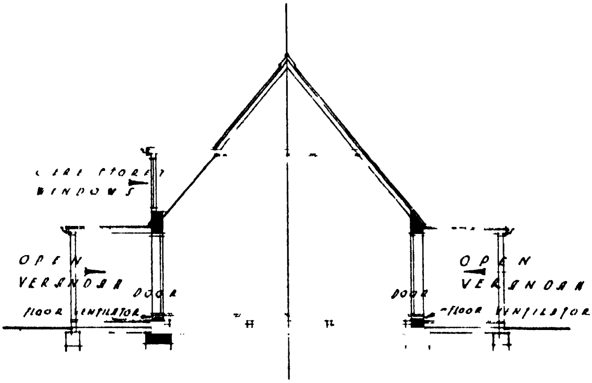


FIG. 87. *Cross section of a Semi-open-air Classroom with a verandah on each side.*

Fig. 87 shows a cross section of a classroom built on open-air lines, with large folding doors leading out of the classrooms on to an open verandah on each side. In good weather the doors on both sides of the classrooms can be fully opened, and on windy days the weather side can be partially or wholly closed. The roof in the diagram is not of the Mansard type, and the additional lighting is arranged for in this case by means of dormer windows above the level of the roof of the verandah on the north side.

Further experience, however, showed that it is sufficient

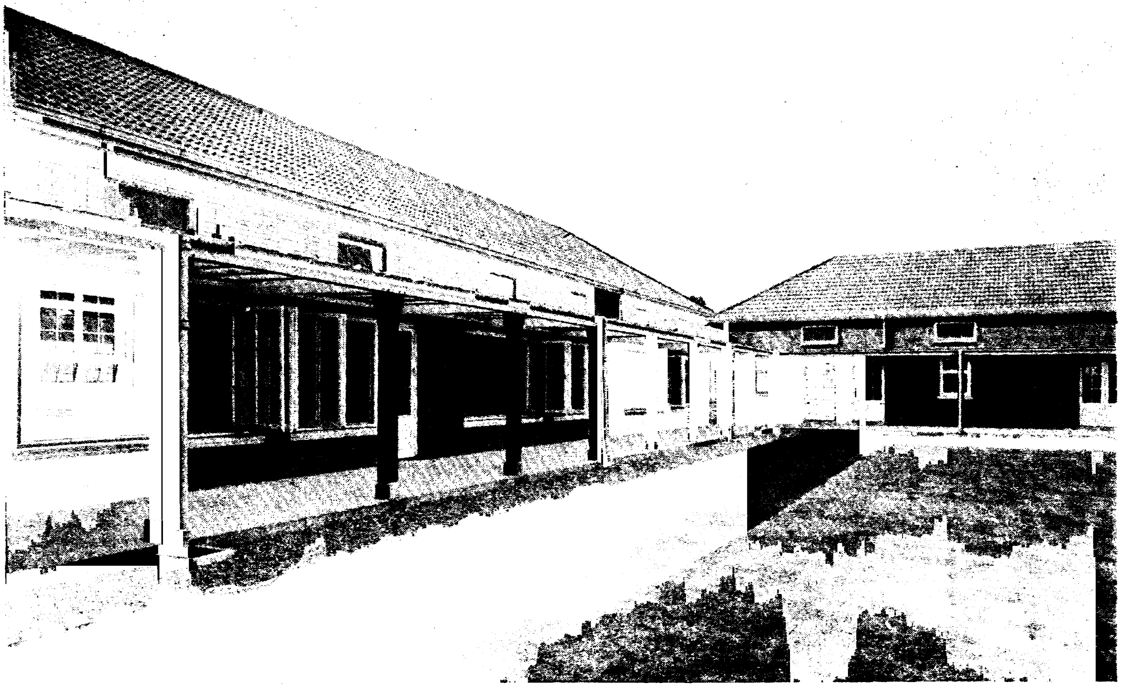


Fig. 88. *Quadrangular Type of School with verandah on one side and dwarf walls and windows on both sides of the classrooms*

for a school building to have a corridor or verandah on one side only, and moreover, this modification considerably cheapens the cost of erection.

As the children sometimes complained of their feet being made cold by the draughts along the floor when the folding doors on both sides were open, the next modification was to arrange for the folding doors to be on one side only, opening on to a verandah or corridor.

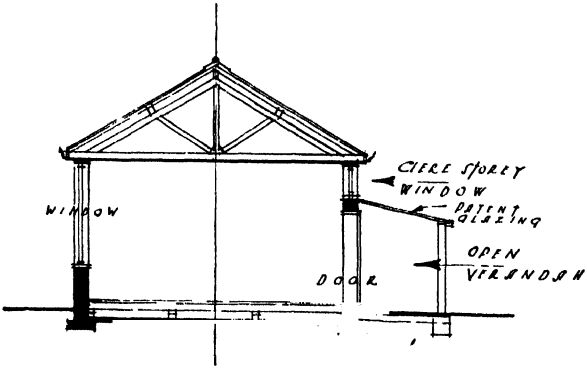


FIG. 89. *Cross section of a Semi-open-air Classroom with a verandah on one side and windows and dwarf wall on the opposite side.*

A further modification to obviate floor draughts was for a dwarf wall about 18 inches high to be built on the side of the classroom on which there was no verandah. The whole space above this wall was fitted with windows which could be opened completely (see Fig. 89).

Some architects have gone so far as to provide a dwarf wall on both sides of the classrooms. Such an arrangement, however, means that windows have to be used in place of the large folding doors on the corridor side (see Fig. 88).

Formerly, Local Education Authorities were required to plan any new schools which they proposed to erect in accordance with certain Building Regulations drawn up by the Board of Education. The Board, however, withdrew these Regulations in 1926 without issuing new ones, and, as the absence of any such guiding regulations caused much inconvenience, the Board in 1936 brought out in booklet form, " Suggestions for the Planning of Buildings for Public Elementary Schools," instead of issuing any new Building Regulations.

These suggestions were drawn up on the assumption that future schools would, in the main, be planned in accordance with the principles laid down in the Hadow Report ; as separate schools for infants, for juniors, or for infants and juniors, or for seniors, either as senior mixed schools, or as separate schools for boys and girls. The remainder of this chapter is largely a summary of information obtained from this source.

If sufficient land, say at least 2 acres for each department, is available at a reasonable price, the school should be built as a one-storey building. The site should be fairly level, but if on a slope, this should be towards the south, in order to get the full benefit of the sunshine. Low lying, damp or made-up land cannot be considered as suitable for the building of a school. Although conveniently accessible to the homes of the children, the school should be built, as far as possible, away from the main traffic routes.

Infants' Schools. The ordinary classrooms in an Infants' school, whilst allowing at least 10 square feet per child, should not be less than 520 square feet in area. The furniture, which should preferably consist of dual tables and chairs, fitted with rubber tips, should be of light construction, so as to be easily movable. Built-in cupboards should be provided for the storage of books, toys and school materials.

In some schools a special class, known as a " Reception Class," is provided for the new five-year-old admissions, the special feature of such a class being larger classroom space, with easy access to the lavatory and offices, etc., and its equipment with suitable furniture, apparatus and toys.

In a large Infants' school the provision of a hall is essential for physical training, music, rhythmic work, and for the holding of parents' meetings, etc.

Junior Schools. The requirements for these schools are similar to those for Infants' schools, except that no provision is necessary for a Reception Class, though one or more rooms for elementary art and light craft work might, with advantage, be provided.

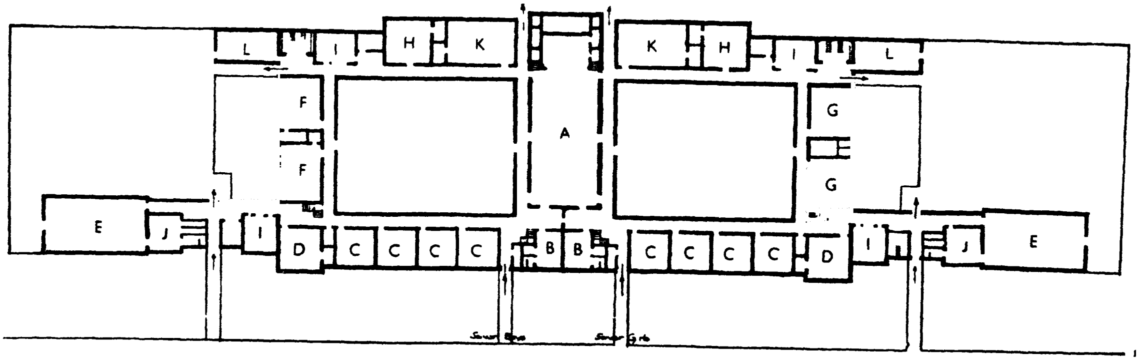
Senior Schools. These schools should be planned to provide a four years' educational course, and the Board suggests that with this object in view the accommodation should be divided almost equally between classrooms and practical rooms for manual or domestic work, science, art and craft work.

The classrooms should be planned to accommodate 40 children, with a floor-space allowance of at least 12 square feet per child. Considerably more floor-space allowance is required, however, for the practical rooms. A large hall should be provided and, if possible, a separate gymnasium.

The Board also suggest the advantage of having a library attached to a Senior school.

Where children do not go home for dinner at mid-day the hall or the housecraft room in smaller schools might be used as a dining-room : in larger schools a separate dining-room may have to be provided. Where there are no cooking facilities on the premises there should be at least a simple " Kitchenette " where milk and other drinks can be heated.

Classrooms. The best shape for a classroom is an oblong, the windows being arranged along the longer sides, thereby affording economy of space in front of the first row of desks. In order that all the children may have a good view of the blackboard and the teacher be able easily to supervise the whole class, the classrooms should never be less than 20 feet wide, but if the heating pipes and radiators cannot be hidden or recessed the width should not be less than 21½ feet,



A. Hall.
B. Head Teacher.
C. Classroom.
D. Craft.
E. Gymnasium.
F. Manual.
G. Domestic Science.
H. Library.
I. Cloaks.
J. Changing.
K. Special.
L. Latrines.

FIG. 90. *Plan of Modern Senior School (Boys' Department on the left : Girls' on the right).*

Where the classroom has a flat ceiling, and is not more than 20 feet wide its height need not be greater than 11 feet, but if there are large windows on both sides of the room the height need not exceed 10 feet. The windows should be so distributed as to light evenly and sufficiently all the desks or tables, the main source of light coming from the left, whilst there should be no windows directly facing either the children or the teacher. The minimum area of unobstructed window space should be the equivalent of one-fifth of the floor area. The tops of the windows should reach as nearly as possible to the ceiling, whilst the lower levels should be not higher than the eyes of the children when seated at their desks.

As the ordinary window glass cuts out the the health-giving rays at the ultra-violet end of the spectrum, a form of quartz glass has been manufactured which allows a considerable proportion of these ultra-violet rays to be transmitted, and it has been suggested that such glass might be used with advantage in schools.

In estimating the possible benefits that may result from the installation of such quartz glass windows in classrooms, it must be appreciated that ultra-violet rays do not penetrate ordinary clothing, so that only a small proportion of the bodies of the children (the heads and the hands) could receive the ultra-violet rays, and even then probably only in the case of those children sitting near to the windows. As long as such patent glasses are more costly than the ordinary glass it is doubtful whether the benefits obtained would make their installation throughout an ordinary school worth while. On the other hand, there are certain positions in which quartz glass might be advantageously used, as for example, in the roofs of rest sheds in an open-air school, and in the windows of Mansard roofs. Where such glass is installed it must be cleaned frequently, for dirt reduces very considerably the power of the glass to transmit the ultra-violet rays. With the object of diffusing the light, the ceiling and a frieze of about 2 feet in depth should be coloured

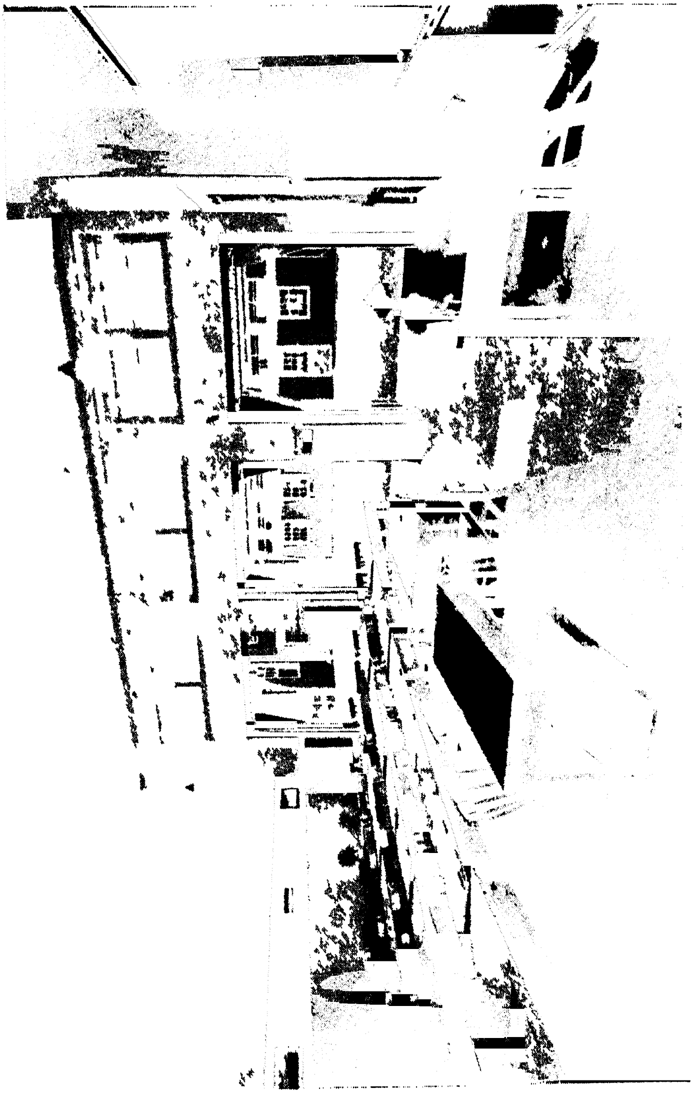


FIG. 91. *A modern type of Classroom.*

white, and the walls between the frieze and the floor level should be of a light colour, since colour has an important bearing on the amount of light reflected. Thus white paint reflects 75 to 80 per cent, of the light falling on it ; cream, ivory or primrose some 60 to 70 per cent. ; light greens, greys or pink, 45 to 50 per cent. ; dark greens or greys, 20 to 25 per cent., and red, only 10 to 15 per cent. In order to prevent glare the surfaces of the walls and ceilings should not be of a shiny nature.

The Board made certain suggestions with regard to *Artificial Illumination* of which the following is a summary:—

Wherever practicable, electricity should be used for artificial lighting. Four units, suitably distributed, are usually found sufficient for a standard classroom, but supplementary illumination may be necessary for the blackboard and teacher's desk, such lights being screened from the direct view of the children. The power of the various units should be such as to throw on to each desk or table an illumination of 10 foot-candles. The lighting of all practical rooms should have a similar illumination, with the exception of needlework rooms, which require an illumination of 12 foot-candles.

A foot-candle is the unit of measurement for light ; and is equivalent to the amount of illumination given by a standardized candle at a distance of 1 foot. By 10 foot-candle illumination is meant the amount of light which would be received from ten such standard candles 1 foot away.

It should be borne in mind that dirt or dust on the lighting fittings, or on the walls or ceilings, and also deterioration of the lighting sources, can, within even a few weeks, diminish the illumination by as much as 30 per cent. Lamps and fittings should accordingly be cleaned at intervals of not more than one month.

The general principles and methods of ventilation are described in Chapter 4. Briefly, the principal means now utilized for the *ventilation of classrooms* by natural methods

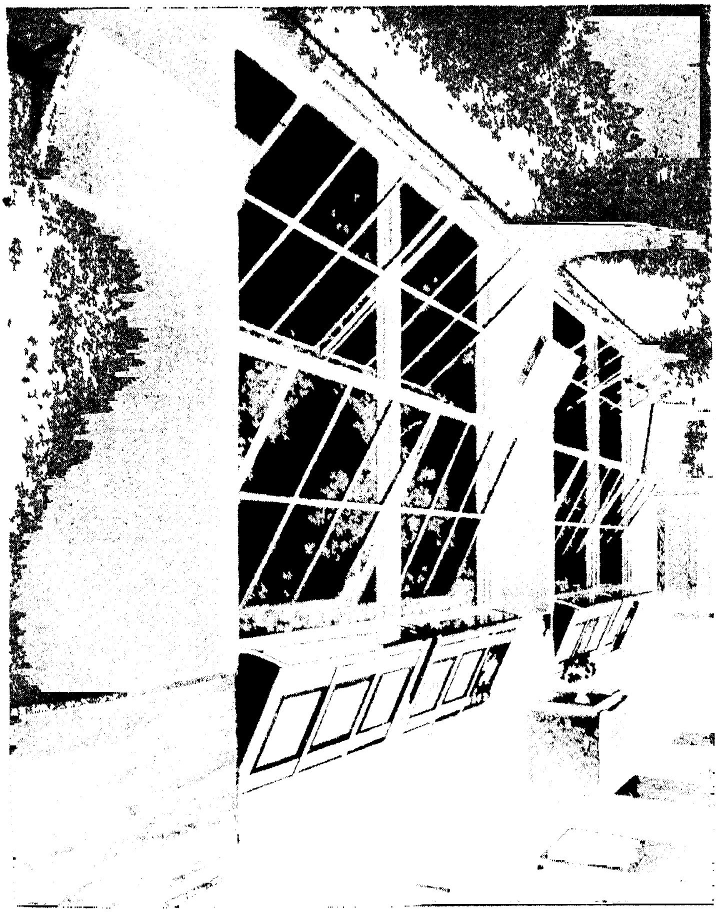


FIG. 92. *Radiant Heating of Classrooms by electrically-heated plates.*

(Photo kindly lent by Unity Heating Ltd, the makers of the apparatus.)

comprise horizontally—or vertically—pivoted windows, sash windows, hopper ventilators, large folding doors, and windows of the Esavian type. A popular practice at the the present time is to provide on the two opposite sides of the room horizontally-pivoted windows in conjunction with hopper ventilators, which are windows hinged below and provided with side cheeks. The windows open inwards, and are so designed as to deflect incoming air in an upward direction, in order to obviate draughts on the heads of the children. They should be so placed that the top of the hopper inlet is about 5 feet 6 inches from the floor (see Fig. 92).

The Heating of Classrooms. In planning the arrangements for the heating of a school, the details regarding the proposed methods of ventilation must also be taken into consideration, since these two systems are closely interrelated, and when properly balanced promote a feeling of warmth, and also keep the air fresh and free from draughts and any body odour. The feeling of warmth or cold is dependent upon the rate of heat loss from the body, which is influenced by the following external factors: the temperature, humidity and speed of movement of the air, and the amount of radiant heat being received.

Since modern classrooms are built largely on open-air lines, heating based on the principles of convection is not practicable. Even if it were possible, the expense of heating rapidly changing air would render it prohibitive. The warming of such classrooms is accordingly done by means of radiant heat, which is unaffected by air movement, as radiant heat affects only those objects which it strikes.

The amount of heat radiated from any given source is dependent upon both the temperature and the area of the radiating surface. Thus the sum total of the radiant heat given off from a warmed floor surface may be even greater than that given off by a coal fire, and by the former a much more even distribution of heat is provided.

FIG. 93. *Sub-floor Classroom Heating.*

One form of heating by radiation is by means of hot-water pipes connected with radiators, conveniently spaced throughout the rooms. A variation of this method is to run the hot water pipes in trenches under the floor, which is thereby heated to a temperature of about 70° F. (see Fig. 93).

Another method which has been tried is to place the hot-water pipes behind the plaster of the walls. A later variation has been to attach the hot-water pipes to metal plates embedded in the ceiling, which is thereby warmed to a temperature of about 100° F., and in consequence heat is radiated downwards to warm the occupants, floor, furniture and walls. In the case of buildings of more than one storey, this method has the advantage of also warming the floor above.

A heating system should be so planned that the walls of the room will be kept at a higher temperature than the air, and the air, at head level, not appreciably warmer than the air at floor level, and that the heads of the children shall not be exposed to excessive radiant heat.

Careful attention must also be given to the placing of all the fresh-air inlets, in order, as far as possible, to eliminate draughts. In this connection it should be appreciated that whether or not any current of air is felt as a draught depends upon its temperature. The reason why, in cold weather, draughts are sometimes noticed in the neighbourhood of windows, is that the cold windows cool the warmer air, which becomes denser in consequence and descends. Draughts from such a cause can be prevented by placing small radiators beneath the windows.

When heating by hot-water pipes is to be installed, the most efficient and economical method is that known as the " Low Pressure Accelerated Gravitation Hot-Water System," in which the slow natural circulation by convection is speeded up by means of a mechanical pump. The heating of schools by high pressure hot-water pipes or by steam pipes is undesirable.

Another form of heating, recently introduced, is by means

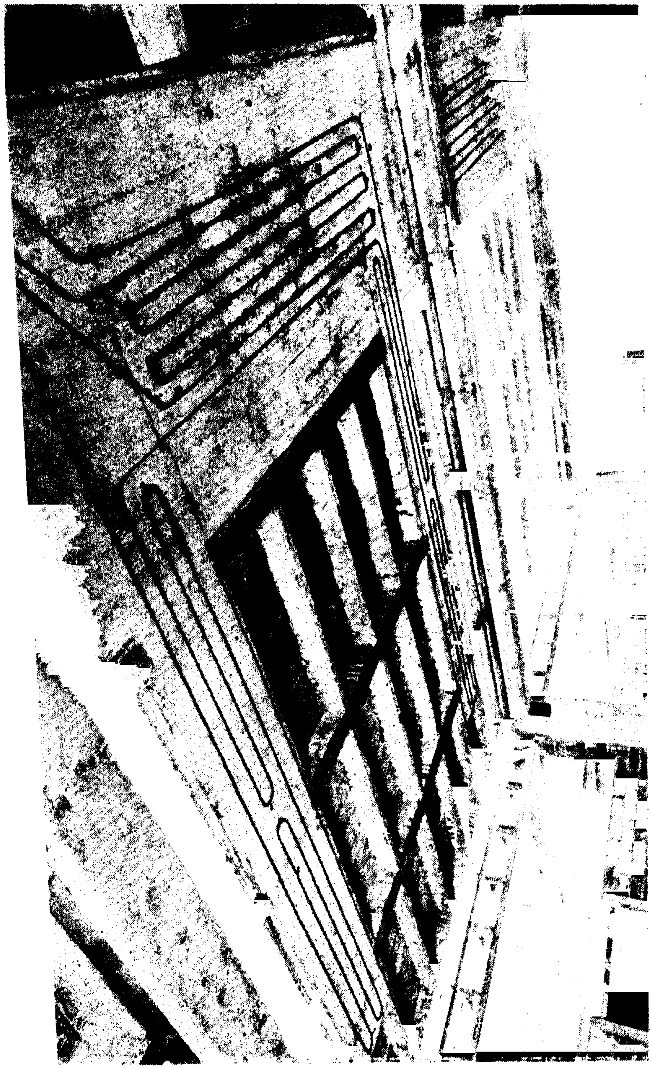


FIG. 94. *Ceiling Panel in course of construction.*

(Courtesy of Messrs. Richard Crittall & Co., Ltd.)

of automatically controlled electric radiators, which are rectangular plates carried on brackets on the walls, and tilted at the most suitable angle, some 7 feet above the floor level. The surface temperatures of these radiators is approximately 400° F. This type of heating is especially suitable for rooms which are ventilated on open-air lines, or have a large area of glass (see Fig. 91).

It is not possible to specify any particular temperature at which classrooms should be kept. The precise temperature for general comfort and health is dependent upon some factors which are constantly varying, namely, the humidity, rate of air movement in the room, the amount of radiant heat and the length of time for which the children are sitting at their desks without a break. In practice, however, it has been found that, generally speaking, a temperature of 60° F. is usually satisfactory: in no case should the room be allowed to fall below 55° F.

As the *classroom floors* have to withstand a considerable amount of wear and tear from children's footwear, the movement of furniture, frequent washing, etc., it is important that only good quality materials should be used in their construction. Patent flooring materials have been tried, but most of these are apt to crack or flake. Where wood floors are used, the type of wood should be close-grained in order to prevent splintering. The Granwood patent flooring is a good type and is composed of small blocks of compressed sawdust. These blocks are rot-proof, and can be given a polish which is not slippery. The makers supply a special spray to be used for polishing purposes.

Wood blocks, on the whole, appear to make the most satisfactory floors. Maple is perhaps the best for general use: it is cheaper than pitch pine, though both these woods last well. Plank flooring boards nailed to the joists leave spaces beneath, and are unsatisfactory on account of the noise caused by movements, but this objection can be overcome by nailing them directly on to breeze concrete. As it is difficult to keep clean the angles where the walls and floor join, the rounding of these junctions is desirable.

Classroom Furniture. Desks. There has of recent years been a definite trend on the part of Education Authorities to provide tables in place of desks for *all* departments, and where this is done it will be necessary to arrange for locker accommodation in the classrooms or corridors.

Although, from the hygienic point of view, separate tables or desks and seats are desirable, such equipment is not always practicable, since not only is it more costly but the separate tables and seats take up more floor space than the dual desks usually provided: either larger classrooms would have to be provided, or fewer children accommodated in rooms of the usual size.

It is important that the desk and seat should be of a suitable size for each child. There are certain types on the market in which both the seat and the desk are adjustable, but usually these are too expensive for general use. Since in most classes the children vary in size, each classroom should be equipped with at least three different sizes of desks and seats, one half of the desks being of a size suitable to the average sized child of the class, one quarter the next size smaller, and the remaining quarter the next size larger.

When considering the suitability of the seats the points to be noted are their height from the floor, the seating surface, and the back rest. A seat is of the proper height for a particular child if, when sitting erect upon it with the feet placed flat on the floor, the thighs are exactly horizontal and the legs vertical, thus forming a right angle with the thighs. The seat, which should have a slightly backward slope, should be saddled and deep enough from front to back to support the thighs, and its front edge should be rounded off so as to obviate any undue pressure on the thigh by the edge of the seat. The back-rest should support the hollow of the back and its top level should not reach the lower angles of the shoulder blades.

The *desk* should be of such a height that when the child is correctly seated, with the upper arms in a vertical position close to the sides and the forearms bent at right angles to the arms, they should just rest comfortably on the desk. The top of the desk should be sloped at an angle of about 15°, as this slope facilitates writing or drawing.

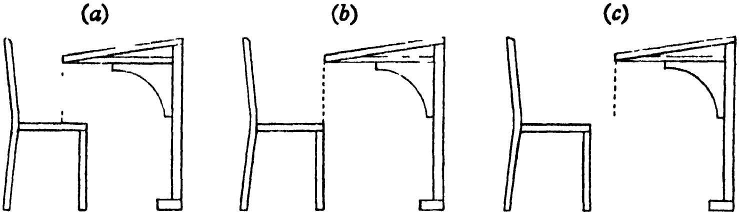


FIG. 95. *Diagram showing the relative positions of desk and seat.*
(*a*) Minus position. (*b*) Zero position. (*c*) Plus position.

Another important point for consideration is the perpendicular relationship between the back edge of the desk and the front edge of the seat. If the edge of the desk overlaps the edge of the seat this is referred to as a " minus " position. If they are in the same perpendicular line this is called " zero " position, and if there is a gap between the two, this is called a " plus " position. The most comfortable and hygienic position for all-round work is the " minus," and if non-adjustable desks are supplied with seats attached they should always be of this type. The disadvantage of a " plus " position is that when writing or drawing the child sits on the edge of the seat and arches the back, thus contracting the chest and compressing the abdominal organs. The position thus adopted soon produces fatigue. Footrests for desks are not necessary, and have the disadvantage of rendering the cleaning of the floors more difficult.

In the case of the youngest children in the Infants' department, light tables and chairs are often provided, as the flat surface of the table is convenient for the materials with which the children work or play, and the tables and chairs can be easily moved when the room is required to be cleared for games, etc. As moving the tables and chairs is apt to be noisy, it is useful to have the ends of the legs fitted with some form of silencing apparatus, such as rubber.

Blackboards. Slate blackboards are now seldom used, having been replaced by boards made of plywood, painted green or black, and finished with enamel. There is a patent preparation, known as hyloplate, which can be obtained with a green surface, and this, though more expensive, is very satisfactory. It has a dull surface and never gets shiny, and lasts for years without treatment. The modern practice is to instal the blackboards as reversible wall boards, inclined with a slight forward tilt, with the object of preventing glare. A chalk ledge is provided at the bottom of the board as a receptacle for chalks and to catch the chalk dust. When dustless chalks, which are more expensive than ordinary chalks, are not used, the dust can be minimized by using as a duster an absorbent material, such as felt.

The National Institute of Industrial Psychology in 1938 published a Report entitled "Improving the Blackboard." This Report covered certain investigations, which included some classroom experiments, made for the purpose of endeavouring to minimize the strain felt by children in copying from a blackboard. They recommended that the board be coloured a light-yellow or primrose, a little lighter than British Standard Colour No. 54, and that a dark blue chalk be used for writing upon it. In a series of experiments upon over 1000 children in elementary schools under classroom conditions, the children were found to copy, on the average, nearly 10 per cent. more from the yellow board than from a blackboard in a similar period of time.

A Medical Inspection Room should be provided for the use of the doctor and the nurse on their visits to the school, and it should have a length of 20 feet in one direction to allow for the standard distance for eye-testing. This room should have some supplementary form of heating, independent of the central heating for the whole school, since when this is not available it may be necessary to warm the room, if the children are to be stripped for examination. A wash basin, fitted with hot and cold water supply, is necessary. Adjacent to the medical examination room there should be a small waiting-room for parents.

Cloakrooms. There should be separate ones for each sex. They should be well lighted, cross-ventilated, and warmed in order to dry damp garments. The floor should be constructed of some impervious material, such as natural rock asphalt. Not more than two rows of pegs should be provided, and the pegs should be so arranged that any peg in one row comes midway between two pegs in the other row. The distance between the pegs in each row should be 12 inches in the boys' cloakrooms, and 18 inches in the girls' or infants' cloakrooms. There should also be provided a certain number of boot cages placed near the hot-water pipes, but not too close to them, and children should be encouraged to keep a pair of slippers at the school for use if their boots get wet. As it is very undesirable for children to sit in school in wet garments, special drying arrangements independent of the central heating should be provided.

Lavatory Basins should be provided in the proportion of 12 for the first 100 children and 4 more for each additional 100. In the infants' lavatories the basins should be installed at two or three different levels. A hot-water supply fitted with control taps to prevent scalding is recommended, together with an adequate supply of soap and towels; such provision being regarded as a most effective aid in connection with the personal hygiene instruction in the school. Paper towels have been suggested for use as being more hygienic than roller towels. Their use, however, would be accompanied with certain disadvantages. They are more costly, and not very effective for drying the hands and face, especially in cold weather. In some schools difficulty might be experienced in storing the large numbers required and in disposing of the used ones. There is also always the possibility of the blockage of the drainage system by pieces of wet pulp. The lavatory floors should be constructed of impervious materials.

Drinking Water. An adequate supply of drinking water should be readily available, drawn direct from the mains and not from cisterns. The common drinking cup, formerly provided in schools, may be the means of spreading infection, and in times of epidemics, therefore, they should, if still in use, be removed. In many of the modern schools it is the practice to install drinking fountains, from which a steady jet of water is ejected for a distance of some 3 or 4 inches, the flow of water being regulated by a hand or foot control. A guard is sometimes provided to prevent the children putting their mouths in direct contact with the pipe. One drinking fountain should be supplied for every 100 children.

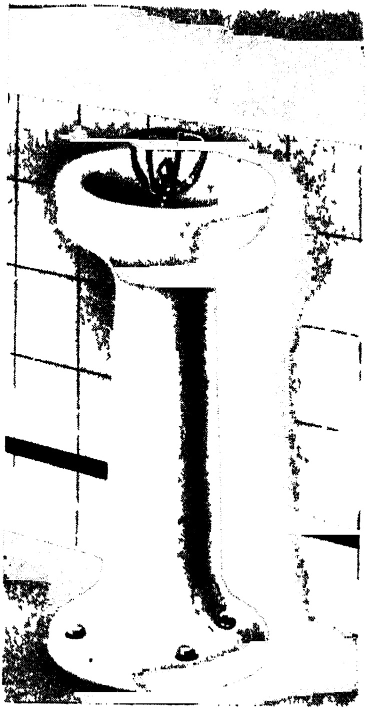


FIG. 96. *A Drinking Fountain.*

(Photo kindly supplied by the makers, Messrs. W. R. Pickup Ltd., Horwich, Bolton.)

Playgrounds. The area of paved playing space required for any particular school is governed by several factors, such as the size of the school, the number of sessions devoted each week to physical exercise, the provision or absence of playing fields. As some guide as to the amount of provision that should be made, it may be mentioned that in the former Regulations of the Board it was laid down that approximately 30 square feet should be provided for each of the older children and 16 square feet in the case of younger children. Whatever provision is made now, however, the playground should be of a rectangular shape and never less than 50 feet wide. All playgrounds should be properly levelled and drained, and manholes and gullies should not be placed in the central parts, and any grids should be level with the surface and not sunk.

As a surface covering, gravel, ashes and cinders are undesirable, because they cause much dirt and dust which are carried into the school building. Concrete, as usually laid, is not recommended because, though durable, it is apt to crack and become slippery in damp and frosty weather. If, however, the concrete be laid down in squares, it does not crack so readily, and if the surface be roughened by being slightly grooved, with the grooves of contiguous squares running in opposite directions, the dangers from slipperiness are lessened. Playgrounds surfaced with granolithic flags are, perhaps, the most suitable; these flags, which do not exceed 3 feet by 2 feet in size, are made of concrete under pressure. Tar macadam is costly to maintain, and experience has shown that worse bruises result from falls on tar macadam than on concrete flags.

School Gardens. The Board recommend that every type of elementary school should have a school garden, which in the case of the Senior schools should be large enough to provide for a properly graded four-year course in gardening, with some special plots reserved for experimental work.

Playing Fields. Every Senior school should have either attached to it, or within easy access, a playing field of two or more acres in size according to the number on roll.

Offices. According to the Board the following sanitary conveniences should be provided: in the case of Girls' schools, 6 closets for the first 100 pupils and 4 additional ones for each succeeding 100, whilst in Boys' schools there should be 4 for the first 100 pupils and 3 additional ones for each subsequent 100 boys. Separate urinal accommodation must be provided for the boys in the proportion of 10 feet per 100 boys. The urinals should have automatic flushing arrangements and should not be placed opposite the W.C. doors.

Closets should be built away from the school buildings, except in the case of those provided for the teaching staff. Separate closets must be provided for the boys and girls, and the approaches to them must be separate. The doors should be at least 3 inches short at the bottom and 6 inches short at the top, and it is also an advantage to have 1½ inches removed from both the hinged and free edges of the door, between the highest and the lowest levels at which children's fingers might be trapped.

In areas where there is a public water supply available, water closets should be provided. These should be of the

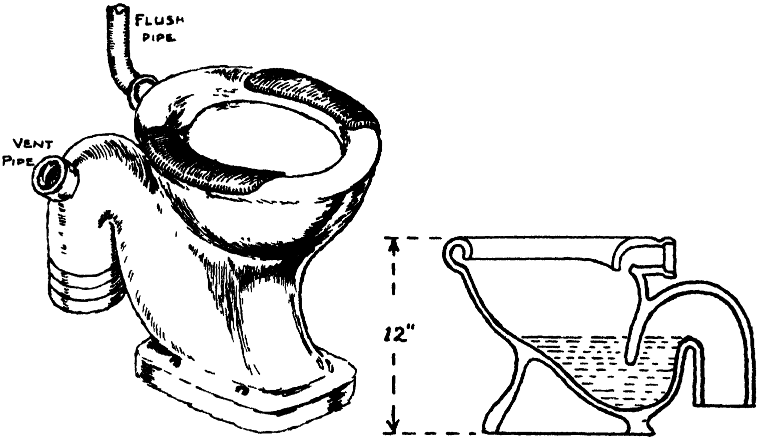


FIG. 97. *Wash-down type of Pedestal Closet for Juniors.*

The section shows the trap with its water-seal.

wash-down type, in which water is always retained at the bottom of the pedestal and serves as a water seal, or trap, to prevent gases or smells emanating from the drain. The seats of the closets for infants should be 10 inches high, while those for the older children should be 12 inches high. Each closet should be supplied with its own flushing supply and a quick-filling cistern supplied from the main.

The floor of each closet should be made of an impervious material and laid with a slope towards the door.

Drainage. The excreta when washed out of the W.C. pass into the soil pipe, which is directly connected with the drain without any intervening trap. For ventilation purposes the soil pipe is continued upwards above the eaves of the building. In addition to drains connected with W.C.s and urinals, arrangements have to be made for the removal of rain-water, and waste water from wash basins, sinks, laboratories, spray baths, etc. Rain-water from the roofs flows into gutters running round the eaves, from which rain pipes discharge on to an iron grating covering a stoneware gully trap which is connected with the drain.

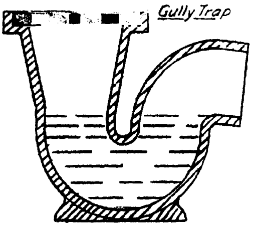


FIG. 98. *Section of Gully-trap.*

A trap is a device to prevent air or gases from coming back from the drain or sewer. There are several varieties of traps, but the principle common to them all is the provision of some form of a U-shaped bend in the pipe, which retains water and thereby acts as a water seal.

In connection with the removal of waste from wash basins, sinks, etc., there is always placed on the outlet pipe under the basin, etc., a trap, usually of a type shaped like an S placed on its side. At the bottom of the bend is an opening closed by a screw cap, for the purpose of cleaning the trap in the event of obstruction. The waste water after passing through the trap discharges in the open air over a gulley-trap, as in the case of rain-water pipes.

The surface water from the playground is also drained away through gulley-traps into the drains.

The drains from the various W.C.s, urinals, and gulley-traps are arranged to converge into one or more inspection chambers, lined with glazed bricks, before entering the main drain leading to the sewer. The chamber is covered with an iron grating which can be removed for inspection purposes. After leaving the last inspection chamber, the main drain has a disconnecting or intercepting trap before emptying into the sewer, with the object of preventing gases from the sewer passing into the drains.

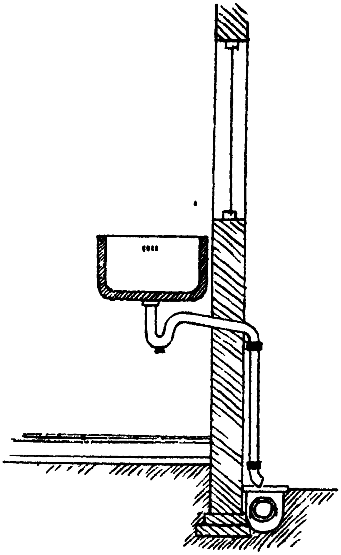


FIG. 99. *Diagram showing Sink with trap underneath, on the outlet pipe, which discharges outside over a gully-trap.*

Where there is no water carriage system, earth closets have to be used. In these closets the excreta are covered over with fine dry earth. The bacteria in the dry soil disintegrate the excreta by oxidizing the nitrogenous matter into nitrites and nitrates. Moulds, loose loams, and garden soil are the best forms of earth for the purpose. About 1½ lbs. of earth is required each time the closet is used, and there are certain forms of earth closets which automatically deliver this amount. The receptacles must be emptied frequently, daily if necessary.

As some children use offices carelessly, constant and strict supervision of their use should be maintained, particularly during playtime. The head teacher should make

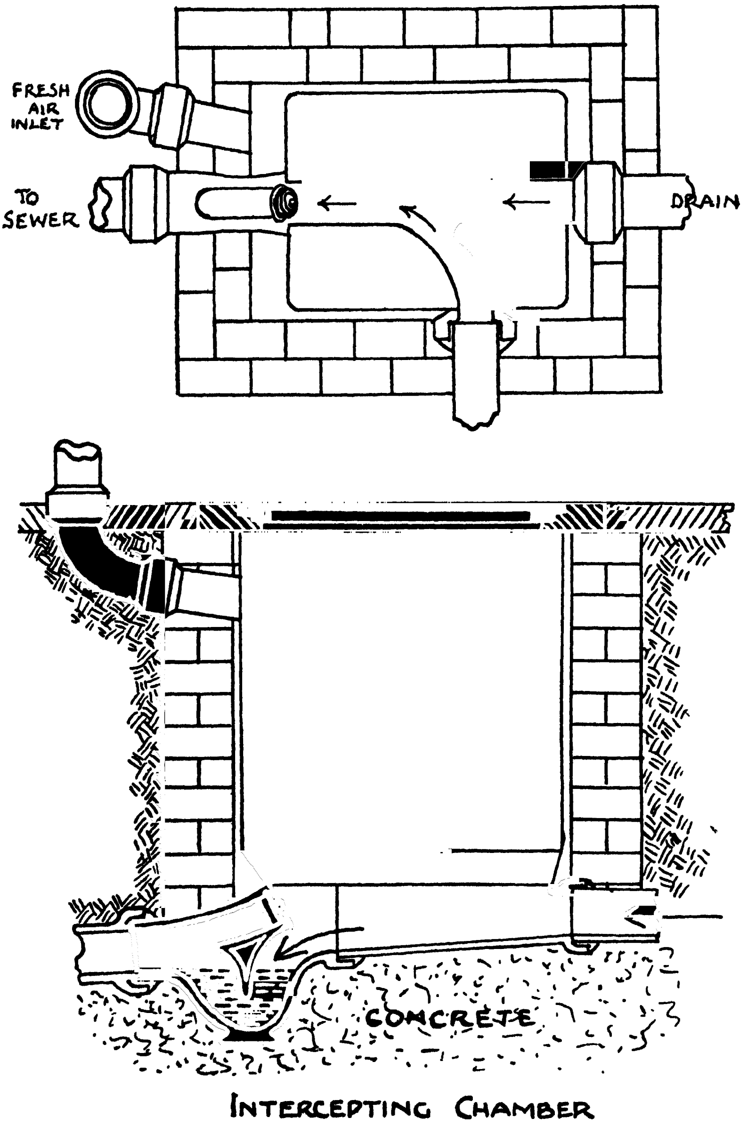


FIG. 100. *An Intercepting Chamber viewed from above, and in section.*

regular inspections of the offices to see that the caretaker is carrying out his or her duties satisfactorily.

The proper use of these conveniences should be made the subject of hygiene talks to the children, and the younger children should be taught how to flush the water closet after use.

Removal of Refuse. Each department should have one or more galvanized iron sanitary dustbins fitted with a lid, for the reception of papers and rubbish to be removed. When the school furnace is working all combustible material might with advantage be burnt in it.

GLOSSARY

GLOSSARY

Actinic rays. The chemical rays of light as distinguished from the heat or light rays. The ultra-violet rays are actinic.

Alopecia [al-o-pē′-sĭ-a]. Baldness: from a Greek word, meaning a fox, because foxes sometimes are affected with a form of baldness which the human variety resembles.

Antibodies. Substances formed in the blood for the purpose of counteracting bacterial toxins.

Antiseptics. Chemical agents which prevent the growth of bacteria (see Disinfectants).

Artesian well. A variety of deep well in which the water, being under pressure below, is forced to the surface. Named after the French province of Artois, where the first of these wells was sunk.

Auto-intoxication. Poisoning from products produced within the body.

Bacilli [ba-sĭl′-ī]. Rod-shaped forms of bacteria: from a Latin word, meaning "a rod."

Centrifugal [centrĭ′-fŭgal]. Fleeing from the centre.

Centripetal [centrĭ′-pĕtal]. Seeking the centre.

Chorea [kŏ-rē′-ah]. From a Greek word, meaning "dancing."

Chromosomes. Microscopical thread-like bodies present in the nuclei of cells. They contain the "genes" or hereditary characteristics of the individual.

Cocci [cŏc′-cī]. Round-shaped micro-organisms: from a Greek word, meaning "berries."

Congenital. Existing at birth, but not hereditary.

Cyst [sĭst]. A tumour containing morbid fluid or the larval stage of certain parasites, such as tape-worms: from a Greek word, meaning "a pouch."

Decalcification. The withdrawal of lime salts from the bones or teeth.

Diathermy. A form of electrical treatment in which the current is passed into the deeper tissues, thus warming them.

Disinfectants. Anything that kills bacteria (see Antiseptics).

Dominant. If two pure bred individuals which differ only in one characteristic, such as colour, be crossed and the offspring completely resemble in colour one parent, this characteristic is said to be Dominant, and the characteristic of the other parent which is masked in the offspring is said to be Recessive.

Dormer window. A vertical window on the sloping roof of a building.

Endemic [ĕn-dĕm′-ĭc]. A term used to denote that a disease is more or less constantly present in the district: from the Greek, meaning "within the people."

Endocrine [end-ō-críne]. The secretion of a ductless gland: from the Greek, meaning "to separate within."

Epidemic. A term used to denote an unusual prevalence of an infectious disease: from the Greek, meaning "upon the people."

Epiphysis [ep-ĭf′-ĭ-sĭs]. A piece of bone attached by cartilage to the end of a bone, and from which growth of the bone takes place.

Fomites [fō-mī′-tēs]. Infected articles or materials, such as clothing, books or toys: from the Latin, meaning "touchwood."

Functional. An abnormality is spoken of as "functional" when there is some derangement in the normal working of an organ, without any underlying organic disease.

Gamete [găm-ēt]. The technical term applied to a cell specialised for reproductive purposes: from the Greek, meaning "to marry."

Genes [jeens]. Units located in the chromosomes of the nuclei of gametes by means of which hereditary characteristics are transmitted.

Glycogen [gli′-cō-jĕn]. A form of carbohydrate of which the body keeps a reserve store in the liver, which is converted back into glucose, as the system requires: from the Greek, meaning "glucose" (or sweet) producer.

Hereditary. Transmitted from ancestors (see Congenital).

Hormone [hŏr′-mōne]. Same as Endocrine: from the Greek, meaning "to arouse to activity."

Kyphosis [kī-fō'-sĭs] A backward curvature of the spine: from the Greek, meaning "bent."

Larva. The term applied to an insect in the stage in which it emerges from the egg, such as the caterpillar stage.

Lordosis [lŏr-dō'-sĭs]. A curvature of the spine with a convexity forwards: from the Greek, meaning "bent inwards."

Metabolism [mĕ-tăb'-o-lism]. The term applied to those processes whereby living tissues transform food materials into tissue elements, and convert complex substances into simpler ones for the production of energy.

Mutations. Variations arising spontaneously in a species and subsequently transmitted in accordance with the laws of Mendel.

Opsonins [ŏp'-sŏ-nĭns]. Substances in the blood which act upon bacteria to prepare them for destruction by the white corpuscles of the blood: from the Greek, meaning "to prepare or cater for."

Orthopædics. A branch of surgery dealing with the prevention or correction of deformities in children: from the Greek, meaning "the straight child."

Parasites. Plants or animals which live in or upon the body of another: from the Greek, meaning "one who eats at the table of another."

Pasteurisation. The process of preventing fermentation in milk by heating it to a temperature below boiling point, thus obviating the objections associated with boiling. The method is named after Louis Pasteur, the French scientist.

Phagocytes [făg'-ŏ-sītes]. Cells having the power of engulfing bacteria. These cells constitute one of the body's defences against infection: from the Greek, meaning "eating cells."

Phthisis [thī'-sĭs]. Tuberculosis of the lungs: from the Greek, meaning "a wasting."

Protoplasm. A protein substance which forms the basis of all living cells: from the Greek, meaning "first form."

Puerperium. The period of time which elapses after the birth of a child until the mother has regained her ordinary health.

Purulent. Containing pus, which is the "matter" found in abscesses, and is composed largely of dead phagocytes and bacteria.

Recessive. See Dominant.

Rhinitis [rī′-nī-tĭs]. Inflammation of the mucous membrane of the nose.

Scoliosis [scō′-le-ō′-sĭs]. A lateral curvature of the spine: from the Greek, meaning "twisted."

Segregation. A hybrid contains, for any particular characteristic, two contrasting hereditary factors or "genes," one obtained from each parent. In the formation of the gametes or germ cells of the hybrid, these dissimilar genes become separated out, so that each gamete contains one or other, but never both, of these genes. This process of the separation of the genes in a hybrid, was termed by Mendel, "segregation."

Sepsis. Infection by pus-forming bacteria.

Spastic paralysis. A form of paralysis in which the muscles affected are permanently in a state of contraction: from the Greek, meaning "drawn."

Staphylococci [stăf′-ĭllŏ-cŏc′-cī]. Cocci arranged in clusters: from the Greek, meaning "a bunch of grapes."

Streptococci [strĕp-tŏ-cŏc′-cī]. Cocci arranged in chains: from the Greek, meaning "a chain of berries."

Synapse [sĭn-ăp′se]. The term applied to the anatomical relationship of the branched nerve endings of one nerve cell with those of another (see Fig. 70): from the Greek, meaning "in contact with."

Toxæmia. A mild form of blood poisoning, due to the absorption of bacterial poisons formed at some localised site of infection: from the Greek, meaning "poisoned blood."

Toxins. The poisons secreted by bacteria: from the Greek, meaning "poison."

Virus. A term applied to the poison of a disease considered, though not proved, to be caused by some micro-organism not yet discovered: from the Latin, meaning "a poison."

Zygote [zī′-gōte]. The earliest form in the development of a new individual arising from the fusion of two gametes: from the Greek, meaning "a joining."

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